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THE ETERNAL GLORY OF AYURVEDA

IN the inscrutable Providence of political conflicts among nations and the resulting domination of one civilisation over another the cultural heritage of the fallen nation very often fails to get due recognition and support from the new Government and its agents and in consequence becomes decadent by sheer discouragement and neglect. This has been the fate of the Ayurvedic system of medicine during the last over one century. The further establishment of Western medicine as the official system enjoying the sole monopoly of State patronage till very recently has made matters more difficult for the practitioners of the indigenous systems of medicine. This circumstance has driven the best brains of the nation from cultivating their cultural heritage.

During the last fifty years, however, patriotic attempts have been made by interested individuals as well as public bodies to get fairplay and due recognition for the National healing art which was performing its duty successfully before its replacement without adequate reason and enquiry by the more costly Western system. The writer has been taking a purely scientific and especially chemical interest in this subject and has profited by taking part in the Fourteenth All-India Ayurvedic Conference, Colombo, 1924; in the Second Karnataka Ayurvedic Conference, Bangalore, 1926; and in the Twenty-first All-India Ayurvedic Conference, Mysore, 1930; in addition to professional discussions with Ayurvedic practitioners, and reviews of reports published by the various committees of enquiry appointed from time to time into the indigenous systems of medicine and their drugs.

In view of the recent rather acrimonious controversy in the Madras Daily Press, over a recent alleged public announcement by the Honourable Minister for Public Health of her intention to encourage the indigenous systems of medicines, the writer welcomed an opportunity to place his own scientific impressions on this subject for the patriotic consideration of his fellow-workers in modern scientific pursuits.

It should be remarked at the outset that it is to the lasting credit of the votaries of the ancient Indian system of medicine that they called their professional art by the name of Ayurveda (*Ayur* = life, *veda* = scientific knowledge), that is, the science of life and of healthy longevity. Medicine in their eyes was not a catalogue of makeshift devices to get over disease and re-establish bodily ease, but it was the synthetic embodiment of all the scientific facts underlying and regulating the life of man in its varied physical, physiological and psychical aspects and stages, in a word, the science of life as a whole.

To the critical student, the *Vedas*, which form the holiest of Hindu scriptures, are known to be important treatises on medicine and surgery, the *Rigveda* dealing mainly with the former and the *Yajurveda* and *Atharvaveda* with the latter. These three *Vedas* are the principal sources of Ayurveda. With these as foundations, fundamental treatises of Ayurveda have been written by Charaka, Susruta and Vagbhata. Among the important branches of Ayurveda treated in these works are, (1) the science of pulse examination, (2) the science of bacteriology and (3) the science of vivisection.

The science of pulse examination formed the basis of the doctrine of *Tridhatu* or *Tridosha*, popularly known as the *vata*, *pitha* and *kapha*.

These are supposed to represent the respiratory, circulatory and nervous mechanisms of the human system and the maintenance of bodily health is believed to depend upon a perfect equilibrium and interdependence of these three essential functions.

The Ayurvedic writings of Bodhayana, Kausika and others are full of references to different kinds of bacteria relating to different diseases.[1]

Regarding vivisection, it is interesting to know that the sacrificial texts of *Yajurveda*, especially the *Adhana panchaka* of the *Srowta bhaga*, deals with nothing but vivisection not of some sporadic instance of the animal world but of a systematic and graded study ranging from birds and reptiles upto man himself who is the crown and completion of all living creation with clear references to as many as forty different species of the animal kingdom.[2] In such studies the subjects to which importance was attached were of three kinds:—(*a*) the functioning of individual visceral organs, (*b*) the five main physiological systems of alimentary-circulatory, respiratory, cerebro-spinal, autonomic, and the genito-urinary, called respectively in Samskrit as *annamaya, pranamaya, manomaya, vignanamaya* and *anandamaya kosas*, and (*c*) the phenomenon of sex metamorphosis which is still a mystery to modern scientists; besides various other interesting studies relating to the therapeutic action of certain drugs on animal bodies. These are fully explained in the *Soma panchaka* of *Srowta bhaga*.[3]

As the Calcutta University commissioners truly observe in their Report (Vol. V, p. 58), "the ancient system of Indian medicine possessed an imposing treasure of empirical knowledge and technical achievement which cannot be safely ignored even in these days of rapid progress". The chief difficulty, however, lies in the fact that all this learning is written in Samskrit without a knowledge of which it is difficult to get at the originals. Owing to long neglect the art has decayed along with the practitioners but in the interests of knowledge it should be resuscitated and made efficient in practice by taking the fullest aid of modern scientific knowledge and vitality.

As *Rajamantrapravina* P. G. de Souza put it before the Mysore Ayurvedic Conference,[4] "it is imperative that every university should open a department of Indian Medicine not only to qualify persons wishing to do so but to carry on research in order to make the Indian system of medicine fully self-sufficient and efficient. It is rather strange that a proposal to establish a chair of Indian Medicine is often met with a chorus of opposition on the plea that such activities are not consistent with modern traditions though people have no objection to create chairs in fanciful subjects like archæology or palæontology. The training of Ayurvedic practitioners should include a study of the general principles of all sciences connected with medicine. The science of Ayurveda itself should be subjected to constant examination in the light of modern scientific methods and a spirit of growth and vitality infused into it."

So much for the essential value and necessity for the restoration and development of Ayurveda on its original foundations. In this respect as the President of the same Ayurvedic Conference remarked,[5] "it should be borne in mind that the official system of Western medicine is constantly trying to evolve better methods of diagnosis and sounder methods of treatment and forge new weapons of precision to combat diseases. In fact for this purpose they have absorbed in their practice many medicinal agents from the Ayurvedic materia medica, *e.g., Kutaja* (Kurchi) and several others. In fact, when Ayurveda was official and flourishing in this country the great living maxim of Charaka was well kept in mind by every physician :

तदेव युक्तं भैषज्यं यदारोग्याय कल्पते ॥

(Whatever is conducive to the cure of diseases is the proper remedy.)

Looking at the matter from a chemical point of view one is struck by the large number and variety of natural products employed successfully as curative materials by the Ayurvedic practitioners as a result of the immensity of valuable therapeutic knowledge of these accumulated by centuries of observation. It has been the practice among advocates of indigenous drugs for use in the Western system of medicine, to extract some of these drugs for what are known as active principles with a view to employ the latter for the same purposes as the crude drug. This practice, which had currency for some time, soon proved dangerous as it was frequently found that the extracted principles very often had not even a fraction of the efficacy of the crude drug. As has been shown recently by Miss Irani in the case of Kurchi seeds the constituents of a crude drug responsible for its curative action may be in a different and much more complex stage of combination than the substances usually isolated from them in the form of the so-called active principles.[6]

The question therefore of substitution of Ayurvedic drugs by their so-called active principles may be fraught with dangerous consequences and hence researches on indigenous drugs should be undertaken with simultaneous proper arrangements for systematic clinical trials of extracts or principles prepared from them.

Besides the chemical aspect of indigenous drugs the botanical and horticultural aspects require to be attended to also. Without going into fuller details of other aspects of the matter one may conclude that it is the imperative duty of the Indian Government as well as of the practitioners of Ayurvedic medicine to develop its usefulness and hidden wisdom with the aid of all modern scientific knowledge. This is best done by the establishment of Ayurvedic Colleges wherein full facilities for the cultivation of medicinal plants, their proper characterisation and their investigation by organic and biochemical methods and their application in medicine by clinical trials will be provided. The main responsibility is on the practitioners of the profession and on scientists in general who should organise the necessary professional associations and laboratories and seek governmental assistance on the financial side. In that way only lies the surest road to establish the fundamental glory of Ayurvedic Medicine not only in India but in the whole world as the soundest and yet the

most inexpensive system of medication ever propounded.

All the above arguments regarding Ayurveda apply with equal force to the Siddha and Unani systems of Indian medicine which are based on Ayurveda as pointed out by the late renowned Janab Hakim Ajmal Khan Bahadur in the scheme of the Ayurvedic and Unani Tibbi College established at Delhi as an immortal tribute to his professional patriotism.

P. RAMASWAMI AYYAR.

1. *Report of the Twenty-first All-India Ayurvedic Conference, Mysore*, 1930, p. 75. 2. *Ibid.*, p. 80. 3. *Ibid.*, p. 81. 4. *Ibid.*, p 25. 5. *Ibid.*, p. 3. 6. *Curr. Sci.*, 1946, **15**, 106

EMPIRE SCIENTIFIC CONFERENCE

ON the occasion of the Opening Ceremony of the Royal Society Empire Scientific Conference held in London on June 17, His Majesty the King declared:—

It gives me great pleasure to be here to-day to open the Empire Scientific Conference, and to greet the delegates. It is the first Conference of its kind but I hope it is destined to be the beginning of an era of closer contact in scientific affairs within the Empire. Nothing can take the place of personal contacts. However clearly a man may write, the spoken word has a directness of appeal which cannot be achieved in any other medium.

I am, therefore, very glad to know that you will discuss whether there should be more such meetings as this Conference and this is a question which, I do not doubt, you will answer in the affirmative. Furthermore, I hope that you will arrange meetings of a more specialised character; and that, whether the meetings be general or related to specific activities, they should not always be held in London but periodically in one or other of the capital cities of the Empire.

We have recently emerged from a terrible war in which, with God's help, we and our Allies were victorious. For six years, the means of waging war and securing peace have filled our minds and occupied our days. Our energies were concentrated for the most part upon destroying the power of our enemies. Not only had old weapons to be continually improved, but new ones had to be devised, and in this work the scientists played an essential part. But not all the work of scientists had destructive ends in view. Great advances have been made which are of the highest importance to civilisation in times of peace. They cover a vast range and I will mention only one or two of the more important.

In Penicillin we have a powerful means of fighting disease, the potentialities of which have certainly not yet been fully explored. New insecticides enable us to control and perhaps to defeat the malarial mosquito.

We have increased our knowledge of the effects of shock on the nervous system and of the reactions of the human body to rapid changes of temperature and pressure. We have made great strides in the discovery and production of organic chemicals and synthetic drugs.

Our necessities have led us to make substantial advances in agriculture and veterinary science. We are also better able to forecast the weather, a development which has been, and must increasingly be, based upon international co-operation. It is, of course, of great importance to the growth of civil aviation. So, too, with Radar, which has developed for our protection from attack by hostile aircraft, will contribute greatly to the safety of navigation by air and sea. New methods of wireless communication have been evolved, and electronic methods have been adapted to the timing of events which occur so rapidly as to be beyond the scope of any purely mechanical system. Jet-propulsion has opened up the possibility of flight at speeds greater than that of sound.

Finally, the production of the atomic bomb through scientific prediction and scientific collaboration has brought home to the world with terrifying directness the fact that the increase in man's knowledge of the material universe may be fraught with infinite possibilities of good and evil. This must never be used as an argument against scientific research. It should rather lead us all to seek for ways and means of increasing our respect for moral principles and to endeavour under God's guidance to reject the evil and choose only the good.

There is good reason to believe that the nearness of the war to the civilian population in their homes and in their daily lives, has brought about an awareness of the power of the scientific method and a realisation that what has helped to win the war will also be of service in making the world healthier, happier and more prosperous. We now have to make good the wastage of the last six years and restore our shattered economy, and scientific research must play a great part in reconstruction. It is, therefore, very gratifying to me to note that my Governments in the United Kingdom and in the Dominions and India have all made provision for increased expenditure upon scientific education and research, in spite of many other calls which they will have to meet. We must see to it that the available resources, both in money and manpower, are efficiently applied.

The Empire is a laboratory richly stored with materials and it covers a very wide range of terrestrial and climatic conditions. By co-operation in the Commonwealth we can, therefore, develop a greater and wider field of scientific investigation than any other community, always excepting the United Nations Organization, with which we intend to work to the full. The nations of the British Commonwealth will, I am sure, be ready to play their part.

I now declare the Empire Scientific Conference open and I pray that God may prosper your deliberations.

NUTRITIONAL IMPROVEMENT OF RICE

By A. SREENIVASAN

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THE nutritive value of rice, as of all cereals, lies primarily in its high fuel value. Where, however, it constitutes a high proportion of the total diet, as in India and the East in general, consideration must be given to its content of the major nutrients such as proteins, minerals and vitamins. In assessing the nutritional qualities of rice, the feature of outstanding importance is the high concentration of essential ingredients found both in the outer coat and in the germ or embryo. The outer envelope or bran and the germ together constitute nearly one-sixth of the whole grain, the remainder being the endosperm or polished rice. Between them they contain more than half the mineral matter of the whole grain, a fourth of the proteins and practically all the fats and vitamins; they are also the fractions which are completely removed in the process of polishing.

In spite of this recognized loss in food value which rice suffers on polishing,[1-3] there is a general and widespread preference for polished rice. The reason is not far to seek when it is remembered that rice, unlike all other cereals, is predominantly consumed as cooked, whole grains and not as meal or flour. Trade demands and consumer preferences have, therefore, been determined mainly by external and physical characteristics. Polished rice has a pleasing appearance and texture, it cooks more easily and is digested better[4] than the unpolished grain and, in the raw condition, it keeps far better and can be stored for long periods or transported over long distances without appreciable deterioration. This last quality is the one which appeals to the largest section of both producers and consumers. It is also the chief reason which has militated against the introduction of any major legislation to check the wholesale replacement of unlimited rice by the milled product.

Mode of Preparation of Rice

In addition to the loss in nutritive value which rice suffers on polishing, the wasteful effects of repeated washing before cooking and of cooking in excess of water involving drainage of gruel, both of them again unique operations in the preparation of rice for food, are familiar knowledge.[5-9] Happily, some improvement has taken place in regard to the mode of cooking for, in most well regulated households, only enough water is used as would enable the rice to swell to its proper consistency. Washing losses, which are even more serious than the effects of cooking in excess water,[1] can and should be eliminated if polishing powders such as talc, chalk and glucose are avoided; their use is not being encountered in recent literature except, in a limited way, in Spain, Italy and the United States. Improvements in the cleanliness of mills and storage places are, however, essential since washing is unnecessary in case of clean, milled rice of good commercial quality, the milling in itself being a cleaning process.

Selection of Rice Varieties

Yet another factor to be reckoned in evaluating nutritive quality in rice relates to the general favour evinced by consumers for the fine-grained, long and white varieties of rice which are often poorer in essential nutritional elements as compared to the coarse-grained and coloured varieties of rice.[10, 11] The latter also have thicker aleurone layers.[12] Improvements in rice culture have hitherto been aimed at increasing yield and other hereditary qualities such as grain size, appearance, milling and cooking properties but it should be possible to lay sufficient stress on the nutritive value of the grain as well and to encourage the grower to raise nutritionally rich varieties. As with wheat and barley,[13] manuring is another potent method of improving both the total yield and the proportion of nutritive constituents in rice.[10]

Unmilled Rice

Any improvement in rice quality aimed or achieved through selection of right varieties or reform in mode of preparation for food can only be of minor significance compared to what may be possible through advocacy in the use of whole, unpolished rice. Repeated efforts have, therefore, been made by nutritionists and health propagandists to combat this serious shortcoming in the use of rice as a food grain. It has been suggested that the poor keeping quality of unmilled rice can be overcome by shelling the required quantity from time to time in small wooden hand-hullers or in hand or power-driven hullers which are also available. The practice of preparing rice for consumption by hand-hulling or home pounding has, however, rapidly given place to the custom of using machine-milled rice even in rural areas. The reasons for the abandonment of home pounding are many: small rice mills have been on the increase as cheap electricity became available; better roads and transportation facilities have enabled the paddy-grower to bring his paddy to a mill, thereby sparing the village folk this hard labour. Even small rice-growers are used to sell their paddy and buy machine-milled rice. Thus, home-pounded rice has become more expensive and does not meet the competition of the cheaper highly milled product.[7]

Undermilling of Rice

It has been argued that, while it may not be quite a practical proposition to ask people to go back to hand-pounded rice, even a lower degree of milling would do a great deal of good. Thus, in 1937, the League of Nations' Inter-Governmental Conference of Far Eastern Countries on Rural Hygiene met in Java and recommended the use of undermilled rice in Government institutions and its popularisation elsewhere by education and propaganda. Attention was called to the desirability of checking the spread of mechanical rice mills in rural areas and promoting the availability of undermilled rice to consumers. No new equipment

is needed for its production; it can be obtained simply by less drastic scouring in the mill, either by loosening the huller blades or by avoiding the use of the pearling cone. The Earle process of milling[14] is stated to be a peeling method, the action being entirely one of rubbing rather than impact. This peeling of rice is essentially a special form of undermilling which aims to limit breakage to a minimum and to retain valuable nutrients. More or less bran can be removed depending on the peeling time.

To introduce undermilled rice would necessarily imply the establishment of a standard for control in degree of milling. At present there is no ready method whereby this can be done by visual inspection. A standard requiring other than the simplest laboratory test would not be satisfactory because of lack of facilities in the warehouses and because of the excessive time that would be consumed in grading rice. Several attempts have been made to define the degree of milling precisely and data exist in the literature regarding the loss in weight of the grain in relation to the loss of ash, phosphorus, thiamin, riboflavin, niacin and fat in the course of the milling process.[6,7] No correlation could, however, be worked out between the different values and the degree of milling. Even with regard to weight of bran removed, it has been observed that the per cent. nutrient losses vary from 6 to 25 times as much as the weight loss, being greatest at the stage where the rate of weight loss is least.[9] Hence, weight loss is a very insensitive index of the degree of milling in a nutritional sense and cannot be recommended as a means of control.

Furthermore, if milling is achieved by passage through a succession of hullers, as is usually the case, it is quite conceivable that all the grains entering the machine do not get equally abraded during their passage through the hullers, any difference in the beginning being only accentuated thereafter. In practice, what the miller does is to inspect visually the rice stream flowing from each huller from time to time and to adjust it for a little looser or a little tighter milling according to some standard of colour which he endeavours to keep in mind. No doubt he acquires by training an ability to detect fine differences in degrees of whiteness but such visual standards are not susceptible of rigorous enforcement. It must, therefore, be anticipated that undermilled rice will of necessity be variable in nutritional quality.

In addition to this difficulty in adequately controlling the degree of undermilling, it is not always feasible to provide for expeditious transit of unmilled or undermilled rice from the rice-shelling mills to consumer areas and thus avoid spoilage in storage. Recent work has shown that in addition to insect infestation and onset of rancidity,[15–18] storage of rice results in loss of nutrients, being considerably more than with wheat, whether in whole grain or flour (whole or refined) form.[9,19] Storage losses would obviously be more pronounced with unmilled or undermilled rice and under tropical conditions of temperature and humidity. Hence, stability in storage presents a major problem in the rice industry and the aversion of millers to undermilled rice because of storage difficulties cannot be dismissed as mere prejudice.

The present food crisis has made it necessary, in some areas, to enforce production of undermilled rice, thereby increasing available supply of the grain; consumers have also become less meticulous in their demands because of circumstances. But for the successful development and marketing of undermilled rice as a long-term, peace-time improvement in rice quality, the foregoing problems have to be carefully considered and solved.

Parboiling of Rice

An expedient that has been much less intensively advocated than undermilling is the more widespread use of parboiled rice. The process itself is an ancient tradition and owes its prevalence and popularity presumably to the ease with which shelling and milling are facilitated by it. The grains get swollen in the process of soaking in water and steaming or boiling so that the subsequent drying operation, usually done in the sun, loosens the hulls which are thus removed readily by pounding. The observations reviewed elsewhere,[20] that there is a nutritional advantage in the parboiling of rice, was only subsequent and is still being considered as incidental. It is now generally known that parboiled rice retains, even after milling, a good proportion of its thiamin, niacin, minerals and proteins,[21,6,7] and that the nutritional merit of parboiling is due to the gelation of the starch in the endosperm with consequent imbedding of some of the bran constituents which are thus generally preserved in the kernel even after milling.[22]

Parboiled rice is customarily used in a large part of the country and, in these areas, the product is unquestionably preferred to raw rice by the people accustomed to it. The process, however, is by no means standardized.[23,24] Parboiling yields a grain of creamy to dark-brown shades and much difficulty is experienced in maintaining lightness or even uniformity of colour. There exist also flavour variations some of which are sufficiently prominent to reflect unfavourable on the universal acceptability of the rice; attempts to introduce parboiling in China under present war conditions has met with opposition on this score. The normal blandness of cooked rice and the ease with which it can be blended with other foods make it essential that, for the successful marketing of this type of rice, it should be a product neutral in flavour. Ideally prepared parboiled rice has no objectionable flavour and, while it is desirable as well as possible, to have only a light shade of colour in the finished product, it is not always essential as, after preparation in the normal manner, parboiled rice is always practically as white as regular milled rice, the yellow cast being scarcely discernable.[6]

Rice 'Conversion' Process

In spite of the knowledge, now fairly widespread, regarding the nutritional superiority of parboiled rice and the recognition that the general health of the population subsisting on

this type of rice is relatively higher than that of those who live in sections where ordinary milled rice is the staple,[5,21] there has been surprisingly little progress in process control, through technological improvements, in the production of parboiled rice. Elsewhere, however, there have been several attempts recently to modernize and improve the traditional parboiling process. The most notable among these has been the Rice Conversion Process which originated in England[25] and has been considerably developed in the United States.[26] Briefly stated, the process is as follows:

> The cleaned paddy is introduced into a large vessel which is then evacuated (to 25" or more) for a period of at least 10 minutes. Hot water (75-85° C.) to an amount about one-third greater than the weight of paddy is then introduced under a pressure of 80 to 100 lbs. per sq. inch and the rice is steeped under these conditions with recirculation of the water for a period ranging from 120 to 165 minutes. The times and temperatures required for steeping are said to depend upon the variety of rice being processed, moisture content, the length of time it has been in storage and the colour desired in the final product. The steeping water is then drained off and the steeped paddy is introduced into a large, cylindrical, rotating steam-heated vessel which is then partially evacuated and the paddy heated for a short time. At this point, dry direct steam is introduced and the paddy is heated in this manner for a few minutes. The steam is then blown off and a vacuum of 28 to 29" applied. The product is dried under vacuum in the rotating steam-jacketted vessel until a moisture content of less than 15 per cent. is attained. Final drying is done at atmospheric pressure. The hot, dry "converted" paddy is placed in bins and cooled by passing air through it and allowing it to remain in the bins for at least 8 hours before milling in the usual way.

The process has been in commercial production at Texas since 1941. A somewhat similar process, devised by Malek[27] does not readily reveal a clear distinction from the H. R. conversion process. It has also been in operation on a plant-scale in California since recently.

Claims made for the processes are (*a*) better nutritional value due to retention of water-soluble vitamins and minerals through the milling process, (*b*) resistance to infestation because of sterilisation in process and 'case-hardening' of the grain, (*c*) higher milling yield with fewer broken grains, enabling the processing cost to be met by the reduction in the proportion of low-grade rice in the output, (*d*) storage life comparable with ordinary polished rice in spite of the higher nutritive value and (*e*) better appearance when cooked, remaining as discrete particles instead of forming into a gummy mass; this property makes processed rice preferable to ordinary rice in canning.

These claims, since substantiated,[9] are all essentially those acquired during parboiling.[28,6] Further, it is reported that the H. R. process is definitely superior to the Malek process.[25] Time and experience can alone show whether this process so highly successful in the United States where the rice industry is relatively highly mechanised and where there is no dearth of technically skilled personnel, can be made feasible in our country and, what is more important, offer distinct advantages over the indigenous methods now in use.

Artificial Enrichment of Rice

Another direction in which nutritional improvements in rice are effected has been through artificial fortification or enrichment of the cereal. Here again, the experimentation so far known has been from the United States and has not reached the stage of application to nutritional reform in rice-eating countries. The problem of enriching rice nutritionally is beset with many obstacles. It is more difficult to restore vitamins and minerals to white rice than to flour as in "national"[30] or "enriched"[31] flour because rice is rinsed before cooking. This leads to great losses when vitamin and mineral preparations are applied only to the surfaces of grains. Enrichment must, therefore, be internal if it is to be thorougly effective; in other words, the entire grain has to be impregnated with the nutrients to avoid their loss during rinsing preparatory to cooking. With undermilling or parboiling of rice, at least a portion of the nutritionally valuable factors of the grain is retained in the grain as consumed. On the other hand, it has been contended that both procedures attempt to make use of the natural nutrient content of the unmilled rice which in itself is limited and varies considerably depending upon soil, climatic, varietal and manurial factors under which the rice has been grown. Hence, it is not possible to get a rice "nutritionally well-rounded". Looking at the problem in this way, artificial enrichment of rice merits consideration provided of course it should prove to be feasible.

The problems involved in the enrichment of rice are that (i) the rice shall be prepared in a manner which is commercially feasible and practical, (ii) the enriched product shall be stable to conditions of transportation, storage and household manipulation (washing and cooking) and (iii) the enriched product shall preferably be indistinguishable from polished rice. These objectives have been achieved by a special process* developed in the Roche Laboratories[32] in which the enrichment is performed in two steps by (*a*) producing a fortified premix, and (*b*) diluting the premix with ordinary white rice in a subsequent process.

The premix or rice concentrate consists of ordinary polished or unpolished rice to which the fortifying ingredients are added and covered by a film-forming, edible, water-insoluble coating. When the enriched rice is cooked, the coating softens and disperses so that the nutrients are readily available in the cooked rice. The premix can obtain enough amounts of the vitamins and minerals so that one half pound will enrich 100 pounds of rice to desired levels. The solvents used for coating according to the

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* The author is indebted to Dr. T. J. T. Wells, Chief of the Roche Scientific Division Volkart Brothers, India, for this personal communication.

Roche process are not objectionable from the standpoint of being explosive or highly inflammable. The coating substances have been investigated from the food angle and found to be satisfactory.

The blending of premix with white rice in the rice mills results in the final market form of enriched rice. It has been determined that the premix is homogeneously distributed throughout the finished enriched rice. Usual household washing of enriched rice prior to cooking will not remove more than 3 to 5 per cent. of the incorporated vitamins. Flavour and cooking quality are not also affected by the fortification procedure. It has been claimed that storage of the premix or of enriched rice for one year at room temperature did not affect the potency of the vitamins.

Another method of artificial enrichment, recently reported,[33] involves impregnating the rice, polished in the conventional manner, with a water solution of vitamins (thiamin, niacin and a highly soluble salt, primary sodium phosphate). The rice is dried and coated with a thin collodion membrane. The vitamins are now protected from rinsing losses but are available to the body in the cooked product since the film is removed by the hot water. The rice is prepared with a high vitamin concentration and then diluted 1 : 100 with unenriched white rice.

Artificial enrichment can obviously be effected by addition of nutrients to any desired level called for by public health considerations; further, from an economic standpoint, only 1 to 2 per cent. of the rice requires special processing. On the other hand, with any form of parboiling, the total produce has to be processed whereby it may happen that the processing and drying costs may equal to or exceed the cost of fortifying ingredients. Frequently, however, it happens that the improved milling and storage qualities of parboiled rice ensures its better saleability. Parboiling can also be extended to freshly harvested paddy which otherwise requires storage or 'curing' for some months before the rice from it becomes fit for consumption.[34]

Another factor requiring careful evaluation with enriched rice is the price for the coating ingredient which should not exceed the cost of the vitamins which it is intended to save; on the basis of available figures, it would appear that over half the cost of processing go for the protective coating; besides, the stability of the premix and of enriched rice over a wide range of storage conditions such as exist in the tropics has to be studied.

RESUME

It is significant that the problems of improvement and product development in rice have received attention mostly in the United States and that during the last four years. This is no doubt a direct consequence of the advent of World War II involving the principal rice surplus areas in the East: Indo-China, Burma and Siam and the recognition by the leaders in America of the anticipated demand for rice for army and civilian feeding requirements. Admittedly, the importance of the nutritive value of rice in India surpasses any relative need in the west for control of rice quality. With the aftermath of the war and the threatened world shortage of cereals engaging the attention of the United Nations Organization, it is to be hoped that concerted efforts will be made in India towards raising the status of the rice diet. Quite apart from improvements in selection of varieties and in cooking methods, which can only be achieved by re-education, the corrective measures discussed above are (*i*) encouragement of undermilled rice, (*ii*) extensive use of parboiled rice with reasonable technical control in production and (*iii*) artificial enrichment.

Enforcement in the production of undermilled rice is handicapped on account of the difficulty in controlling the degree of undermilling and of preventing deterioration in storage. Again, although undermilling increases nutritional quality, it does not give the colour or cooking quality required by many consumers and will not attain the equal digestibility of white rice.

There is paucity of information on the practical application of the principles of rice enrichment under tropical conditions. The large-scale synthetic production of vitamins in America and the extensive propaganda by leaders in the nutrition field towards restoration and fortification of certain foods have made the American people definitely nutrition-conscious with the result that they pay attention to enriched values and watch the labels in food packages for vitamin declarations. Conditions in this country are quite different and even if fortification were made possible through import of the necessary protective factors it would be a long time before such enriched foods become popular except when introduced compulsorily and under Government subsidy in which case economic factors are to be carefully reckoned.

The widespread utilization of parboiled rice undoubtedly offers advantages but it becomes absolutely necessary to effect technological improvements and product control before parboiling can be expected to yield an ideal product which combines in it the pleasing appearance and keeping quality of polished rice with the superior nutritive value of unpolished rice.

It is indeed difficult to prescribe the final answer. But, whether it be undermilling, parboiling or fortification, there is no denying the fact that whatever can be done for the nutritional improvement of rice will be well justified by enormous benefits through diminished malnutrition. For better nutritional welfare and widespread dietary improvement, it is the staple food that has to be improved in quality. It is only then that the lower income groups whose total diet contain the largest proportion of cereal foods and who are, therefore, in greatest danger from nutritional deficiencies, get the best advantage.

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A HOME-MADE INFRA-RED SPECTROMETER

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WHILE great advances have been made of recent years in the technique of infra-red spectroscopy, little work is being done on the behaviour of crystals in this interesting region of the spectrum. Infra-red investigations of crystals should provide us with fundamental knowledge about the dynamics of the atoms composing them and are essential for a proper understanding of the nature of the solid state of matter. Great interest centres round the infra-red spectrum of diamond in particular, since this is the simplest of cubic crystals. Fortunately, the most interesting region in the infra-red spectrum of diamond lies in the near infra-red and is capable of being explored with a rocksalt-prism spectrometer. Two years ago the investigation of the infra-red spectrum of diamond was undertaken by the writer at the suggestion of Sir C. V. Raman. Since there was no infra-red spectrometer available in this laboratory, it was necessary to set up an instrument for this research. With the home-made instrument which has resulted, it has been possible to establish some important facts about the infra-red spectrum of diamond. A description of the construction of the instrument, which may be of interest, is given below.

As a source of continuous infra-red radiation a globar is used. Though the widely used Nernst filament has got a higher operating temperature and consequently higher infra-red radiancy, the globar, in virtue of its large heat capacity, serves as a very steady source. The ¼" thick 6" long globar element now being used is mounted inside a water-cooled iron jacket cut with a slit 1" by ¼" in the centre for the exit of radiation.

The arrangement of the optical parts of the spectrometer is indicated in Fig. 1 (not to scale), which is self-explanatory. The spherical glass mirrors M_5 and M_4 which are of 10" focal length and 3½" diameter were obtained

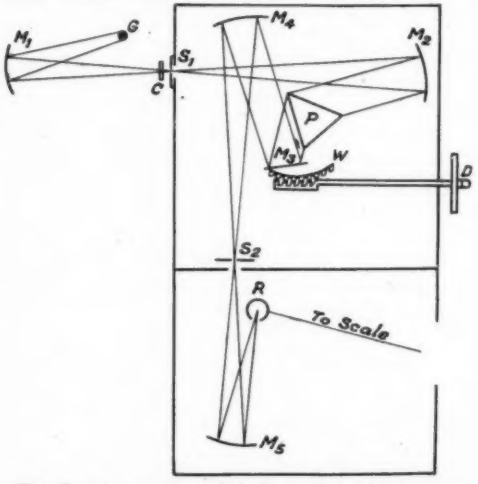

FIG. 1.—*Arrangement of the Home-Made Spectrometer.* G.—Globar; M_1 and M_5—Focussing mirrors; C—Crystal under investigation; S_1—Entrance slit; M_3 and M_4—Spectrometer mirrors; P—Rocksalt prism; M_3—Plane mirror; W—Worm wheel; D—Graduated drum; S_2—Exit slit; R—Radiomicrometer.

from Dr. Parameswaran of Trivandrum and aluminized by the writer. The plane mirror M_3 is 2" by 3" and the focussing mirrors M_1 and M_2 are of 3" diameter and 5" focal length. They were all coated with a strongly reflecting film of aluminium by the well-known evaporation technique. The rocksalt prism P (with a refracting angle of 53° 30' and faces 2" square) was cut, ground and polished from a big crystal in Sir C. V. Raman's collection. The optical parts are all enclosed in a urelite box 12" by 12" by 10". A worm wheel W, attached to the prism table, is capable of being rotated by very small amounts (28 seconds of arc at a time) from outside the box by means of a graduated drum attached to the rod engaging the wheel.

A Boys' radiomicrometer R, also constructed locally, is used for detecting the radiation. The instrument is fitted with a rocksalt window to make it air-tight. The deflections of the instrument on a scale at two metres distance are of the order of 6 centimetres in the 8 μ region of the spectrum with a slit width of a quarter of a millimetre.

The infra-red absorption curves of four typical diamonds obtained with the above instrument are reproduced in Fig. 2. They show very well the differences in the structure and intensity of the 8 μ band for diamonds which differ in their luminescence properties. The band is most prominent in the weakly blue-fluorescent diamond (Curve *a*, N.C. 71, 0·78 mm. thick), less prominent in the strongly blue-fluorescent diamond (Curve *b*, N.C. 79, 1·20 mm. thick), least prominent in diamond N.C. 110 luminescing blue and yellow with great intensity (Curve *c*, 0·80 mm. thick), and altogether absent in the non-luminescent diamond N.C. 60 (Curve *d*, 1·27 mm. thick). While all the diamonds show in the 5 μ region the octaves of the peaks appearing in the 8 μ band, the general lack of detail in this region is due to the inadequacy of dispersion of rocksalt. On the other hand, the dispersion in the 8 μ region is sufficient to show up a great deal of detail, as is seen from the curves reproduced. Along with several other maxima, the curves show the well-known 1332 cm.$^{-1}$ Raman frequency

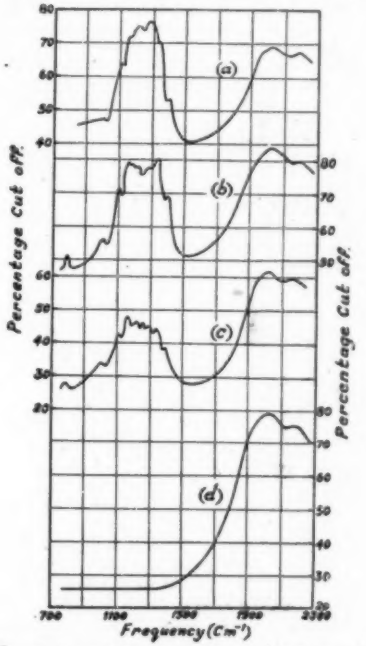

FIG. 2.—*Infra red Absorption Curves of Diamonds.*

(*a*) Weakly blue-fluorescent diamond. (*b*) Intensely blue-fluorescent diamond. (*c*) Diamond fluorescing blue and yellow with great intensity. (*d*) Non-fluorescent diamond.

as an absorption peak. The positions of this and the other peaks agree well with the lattice frequencies of diamond determined from its luminescence and absorption spectra.

MERCURY STANDARD OF WAVE-LENGTH

THE best wave-length standard of the near future will no longer be the red cadmium line which has been standard since 1893, but a green line due to a mercury isotope transmuted from gold. *Science Service* reports on the work done by Drs. Jacob H. Wiens and Luis Alverez, who used the cyclotron of the University of California to bombard atoms of gold with neutrons. When the gold atoms capture neutrons they become radioactive and after emitting electrons become mercury of atomic weight 198, with a purity better than one atom in a million. This purity is reflected in the sharpness and clarity of the spectrum line, which does not vary by more than one 50-billionth of an inch in wave-length.

This mercury line is further superior to the cadmium standard because the mercury can be brought to incandescence at a much lower temperature—actually below freezing, whereas cadmium must be heated to 300° C. Also, mercury atoms, being heavier, do not move about as fast when heated. Both the mass and the temperature of atoms influence the sharpness of spectrum lines; needless to say, the sharper a line is, the more accurately it can be measured.

—Courtesy of *Sky and Telescope*, 1946, 5, 10.

SOME OBSERVATIONS ON SUGARCANE MITE AND ITS EFFECTIVE PREDATOR IN SIND

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BIOLOGICAL control of insects has gained great importance in recent times and attempts are being continually made in several countries to take the fullest advantage from parasites and predators of insect pests in their control. While some attention has been paid to the study of parasites of crop pests in India, their predators have been very little studied. Recently, however, Rahman (1940) has summarized the information available on important predators of India and Kapoor (1942) has studied the role of a number of predators found in the environs of Delhi, while Trehan (1943) has discussed in general the role of predators in biological control.

During the course of survey of crop pests at Sakrand (Sind), a very effective predaceous beetle, *Scymnus gracialis* Motsch, was observed feeding on the sugarcane mite, *Paratetranychus indicus* Hirst, in June 1943. Although sugarcane had been grown for experimental purposes at the Agricultural Farm, Sakrand, for nearly fifteen years, neither this pest nor its predator was observed here before, and neither of these was even reported from any other part of the province. Though recorded for the first time from Sind, *P. indicus* is widely distributed in other parts of India (Rahman and Sapra, 1940), while *S. gracialis* has so far been reported from Coimbatore and Lyallpur (Rahman, 1940).

The attack of this mite was first noticed on 5th June in a small area, about ⅛ of an acre, in the southern corner of sugarcane block; the pest had probably migrated from a wild grass, *Sorghum halepense*, growing some 40 feet further south. The attack progressed rapidly on sugarcane and by the first week of July the whole of the adjoining area under this crop, about 10 acres in size, was so heavily infested that it seemed the entire crop would be destroyed in a short time.

With a view to have some idea of the severity of the pest, a method somewhat similar to the one utilized by Le Pelle (1942) to determine the relative abundance of thrips was tried. By this method 10 heavily and 10 mildly infested leaves were taken at random on 8th July and from about the middle of each leaf, one square inch area was cut and put immediately in a glass tube containing 70 per cent. alcohol. All adults and larvæ of the mite that were killed were later counted; the maximum number of these found per square inch leaf-surface was 275, the minimum 45, and the average of all twenty counts was 128.

It was interesting to watch the progress of attack of this pest. The attack started in the extreme south corner of the sugarcane block and progressed northwards, along the entire length of the area which was about half a mile. It took just three weeks for the pest to reach the extreme northern portion of the block where it was first noticed on 28th June. At this stage, there were all grades of infestation from an extremely heavy infestation in the extreme south to a negligible one in the extreme north. Although the rate at which the infestation progressed was not properly recorded, it appeared from the general survey made that its progress was fairly uniform and may have varied from about 35 yards to 50 yards per day.

The dispersal of the pest was greatly, if not entirely, facilitated by wind. The direction of wind during June and July was from south and south-west to north and north-east, and the attack progressed in the windward direction; the plots on the extreme south being the first to be attacked and those in the extreme north to be attacked last. The mean velocity of wind during June and July was 6-8 miles per hour, but at times it used to be as high as 20 miles or even more.

In all fifteen improved varieties of sugarcane were grown in this block for varietal and sowing date trials. The principal varieties need only be mentioned, and they were Co. 213, Co. 312, Co. 313 and Co. 450. The sowing dates were middle October, middle November and from the middle of February to the middle of March. All these varieties, grown on different dates were badly affected. It was not possible to make detailed observations on the incidence of the pest either in relation to varietal susceptibility or date of sowing because of the number being very large, but from the surveys conducted it seemed that there was little or no difference in the intensity of attack.

The nature of damage done by this mite is somewhat different from what has been recorded by Rahman and Sapra (1940). The leaves did not turn red due to mite attack, but became dry and straw coloured. The mid-rib and some portions on both sides of it remained green and unaffected by this mite. The yellowing of leaves usually started from the tips and progressed towards the base of the leaves. The pest was usually found on the underside of the grown-up leaves, very young leaves were rarely attacked.

Towards the end of June a predaceous beetle, *Scymnus gracialis* Mots., was observed in the plots on the extreme south feeding on the pest. This predator was found in all stages, and both the larvæ and the adults were observed feeding on the various stages of the pest. At first the predator was present in small numbers, but within about a week, from 3rd July onwards, it increased very much in numbers, either owing to considerable migration from outside or because of multiplication or both. It started following the pest from plot to plot, with the progress of the attack. Towards the end of the second week of July the crop in the first attacked area showed signs of revival and on 16th July three acres of sugarcane were

absolutely free from the mite. Owing to such a phenomenal control, through this natural agency, some observations on the population of the predator were made. Twelve leaves of sugarcane were taken at random on 16th July with the consideration that they had large number of either larvæ or adults of the predator present on them. The maximum number of larvæ found on a single leaf was 36 and that of adults was 94. The average of various stages, except eggs, found were 10 larvæ, 11 pupæ and 35 adults.

The final stage in the drama was reached on 29th July when the entire sugarcane block was found free from mite, and only a very small number of pupæ of the predaceous beetle and some adults were found scattered in the plots last affected.

This predator thus seems to possess all the desired characters of an efficient agent in the biological control. It preyed on all the stages of the pest, a single adult consumed as many as 50 mites in 24 hours, and it multiplied in a very short time. From the observations made subsequently, it appears that this predator remains active almost all the year round. During June and July it was found, as stated above, on sugarcane, in September it was observed feeding on *Paratetranychus indicus* attacking a wild weed, *Digera arvensis*, in October its adults were noticed feeding on a scale insect on *Dalbergia sissoo*, and again in February-March 1944 it was found feeding on *P. indicus* infesting *Sesbania ægyptiaca* and *S. grandiflora*.

The host plants of this mite have been recorded from South India (Cherian, 1933) and the Punjab (Rahman and Sapra, 1940). None of them, however, found it on the three hosts, *Digera arvensis*, *Sesbania ægyptiaca* and *S. grandiflora*, recorded in Sind.

It is not possible to indicate all the environmental factors that may have favoured the increase of either the host or the predator, but it was interesting to observe that very hot and dry conditions prevailed during June-July 1943 while both of them were found in very large numbers. The mean maximum temperature of June was 109° F., the highest temperature reached was 123° F. on two days, the mean minimum was 85° F., and the mean relative humidity was 58 per cent. at 8-30 hours. During the first ten days of July the climatic conditions were equally severe, but with a few small showers of rain from 11th July onwards the temperature fell down and the mean maximum for the remaining period was 103° F. with a mean relative humidity of 69 per cent. at 8-30 hours. There was no rainfall in the month of June, but 0·5 inches was recorded in the last three weeks of July.

It is interesting to record that Rahman and Sapra (1940) also found this mite very common on sugarcane during hot and dry months of May and June at Lyallpur, where the setting in of monsoon rains in July kills all the stages of the pest except the eggs. At Sakrand, as stated above, the pest was entirely controlled by the predator, and the rainfall received during the two months of its activity was negligible.

This short note is written in the hope that it will stimulate the study of the relationship of pests and their enemies under natural conditions. One often records the severe outbreaks of pests and tries to explain their causes, but little attention is paid to the role of parasites and predators in suppressing them. Some of the useful natural enemies, such as *S. gracialis*, hitherto considered of little importance in the biological control, may turn out to be of great value.

We are indebted to Dr. Taskhir Ahmad, Second Entomologist, in charge of the Division of Entomology, for giving facilities in writing this note and for help in revising it.

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COLLECTION OF MALAYSIAN HEPATICÆ

THE Farlow Herbarium of Harvard University has received word that a valuable collection of over 3,000 specimens of Malaysian hepaticæ, chiefly Epiphytic Lejeuneaceæ, gathered by Dr. Frans Verdoorn as well as some other collections assembled by him between 1925 and 1926, which were on loan, at the outbreak of the War, to the Botanical Institute of the University of Jena, is safe. Professor Th. Herzog who, with a number of assistants and graduate students, is working on this collection, writes that he placed most of it during the early war years, for safeguarding in a country home near Jena. This house was almost entirely destroyed by a bomb, the specimens, however, were found in undamaged condition in the wreckage of the basement. They were removed subsequently to a part of the basement at the Botanical Institute. This building and most of the basement were entirely destroyed at a later date when nine students were killed and the Director, Professor Renner, was seriously wounded. The bryological collections were fortunately in a wing where the basement withstood the bombing and work on them is now being continued by Prof. Herzog and his assistants, Drs. Benedict and Schuchardt.

—Courtesy of Dr. Frans Verdoorn, Editor, *Chronica Botanica*.

LETTERS TO THE EDITOR

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ON THE VARIATION OF THE ELECTRICAL CONSTANTS OF SOIL WITH THE FREQUENCY OF THE MEASURING FIELD

Two possible causes of polarisation in the soil condenser are—(*a*) the formation of an ionic space charge and (*b*) the orientation of the dipolar molecules in the soil medium. From White's[1] charge and discharge curves the effect of the ionic space charge was shown to have practically no effect except at very low audio frequencies. The variation of the soil constants should thus be attributed to the polarisation caused by dipolar molecules in the soil medium, especially in the region of high frequencies. In the range of audio frequencies, however, the variation of the soil constants due to orientation of molecules is of little importance and so far as the electrical conductivity is concerned, we have to consider the effect of the displacement currents in the soil medium as causing the major portion of soil conductivity. Thus the total electrical conductivity of soil at any frequency of the measuring field can be represented by

$$\sigma = \sigma_0 + \sigma_d + \sigma_p \qquad (1)$$

where σ_0 = d.c. electrical conductivity.
σ_d = electrical conductivity due to displacement currents in the dielectric.
and σ_p = electrical conductivity due to orientation of polar molecules in the electrical field.

Let us first determine the expression for the electrical conductivity due to the displacement currents. If E_x is the sinusoidal potential difference across the soil condenser and E the electric field intensity at a point in the soil medium of dielectric constant ϵ, then taking the displacement along x-direction, the displacement current density would be given by

$$i_d = \frac{\epsilon}{4\pi}\frac{dE}{dt} = -\frac{\epsilon}{4\pi}\cdot\frac{d}{dt}\left(\frac{dE_x}{dx}\right). \qquad (2)$$

Assuming a small space-charge in the soil condenser, so that the voltage gradient at any instant remains practically unaffected, we can write

$$\frac{dE_x}{dx} = a \sin \omega t,$$

where a is a constant and w the angular frequency of the voltage. Thus

$$i_d = \frac{\epsilon}{4\pi}\cdot \omega . a \cos \omega t$$

$$= A \cos \omega t, \quad \text{where } A = \frac{\epsilon . \omega . a}{}.$$

Consider now a small cylindrical element of the current-path in the soil condenser. Let the length of the element parallel to the direction of the current be dl and the cross-section perpendicular to the current path be da. If σ_d is the specific conductivity due to the displacement currents, the power dissipation in this small element is given by

$$(i_d \cdot da)^2 \cdot \left(\frac{1}{\sigma_d}\cdot\frac{dl}{da}\right) = \frac{i_d^2}{\sigma_d}\cdot(dl \cdot da)$$

when averaged over one cycle, the power dissipation in the element is

$$dP = \overline{i_d^2}\cdot\frac{dl \cdot da}{\sigma_d} = \frac{A^2}{2\sigma_d}\cdot(dl \cdot da) \qquad (3)$$

The power dissipation can also be written as

$$dP = \sigma_d \cdot \overline{E^2} \cdot (dl \cdot da) = \sigma_d \cdot \frac{a^2}{2} \cdot (dl \cdot da) \quad (4)$$

since

$$E = -\frac{dE_x}{dx} = -a \sin \omega t.$$

Hence from (3) and (4)

$$\sigma_d = \frac{A}{a} = \frac{\epsilon \cdot \omega}{4\pi} = k_1 \cdot f, \left(\text{where } k_1 = \frac{\epsilon}{2}\right) \quad (5)$$

and f = frequency.

In the audio-frequency range, the contribution of the displacement current to the electrical conductivity is much more pronounced than that due to orientation of the soil molecules. Thus the A.F. electrical conductivity will be virtually of the form

$$\sigma = \sigma_0 + k_1 \cdot f. \quad (6)$$

This has been substantiated by all workers employing audio-frequency currents.

Regarding the expression for the electrical conductivity due to the dipolar orientation, Debye obtained

$$\sigma = (\epsilon_1 - \epsilon_0) \cdot \frac{\omega^2 \cdot \tau \cdot \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)}{1 + \omega^2 \cdot \tau^2 \cdot \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)^2}, \quad (7)$$

and also

$$\epsilon = \epsilon_0 + \frac{\epsilon_1 - 2}{1 + \omega^2 \cdot \tau^2 \cdot \left(\frac{\epsilon_1 + 2}{\epsilon_0 + 2}\right)^2}, \quad (8)$$

where ϵ_0 = constant value of the dielectric constant at high frequency or optical dielectric constant,

ϵ_1 = Static dielectric constant for extremely low frequency,

τ = relaxation time

and w = angular frequency of the measuring field.

According to White, the relaxation time τ for Cambridge soil is about $\cdot 4 \times 10^{-7}$ or 5×10^{-7}, so that even in the radio-frequency range where $w \gtrsim 10^6$, $\omega \cdot \tau << 1$. When $\omega \cdot \tau << 1$, the Debye expressions would be reduced to—

$\sigma \propto \omega^2 = k_2 \cdot f^2$, where k_2 is some constant,

and ϵ = constant for all frequencies.

Thus under the restricted condition $wT << 1$, the total conductivity of soil would be of the form

$$\sigma = \sigma_0 + k_1 \cdot f + k_2 \cdot f^2. \quad (9)$$

Bairsto's[2] work substantiated this relation in the case of marble and slate.

There is yet another effect for our consideration, especially for high values of d.c. conductivity and for the higher frequency range—the skin effect. Considering the skin effect, we can write for the total conductivity of the soil thus:

$$\sigma = \frac{k_0}{\sqrt{f}} + k_1 \cdot f + k_2 \cdot f^2. \quad (10)$$

where k_0 involves the d.c. conductivity.

For extremely high packing, the skin effect is most prominent. The electrical conductivity of soil is, therefore, expected to decrease with the increase of frequency, whereas for lower degrees of packing, when Debye's dipole effect plays an important part, the electrical conductivity is expected to increase with frequency. For some suitable degrees of packing, an increase of the electrical conductivity followed by a subsequent decrease may also be expected with the increase of frequency.

The variation of the dielectric constant with frequency should, however, be attributed solely to the orientation of the dipolar molecules in the soil medium.

Some of the above theoretical conclusions on the variation of the electrical constants of soil with frequency were substantiated by experiments[3] performed by Amalendu Banerjee in this laboratory with different soil specimens packed to various extents. Some typical experimental results for high and low packing with different soil specimens (Calcutta, Dacca and Delhi soils) are shown in Figs. 1 and 2.

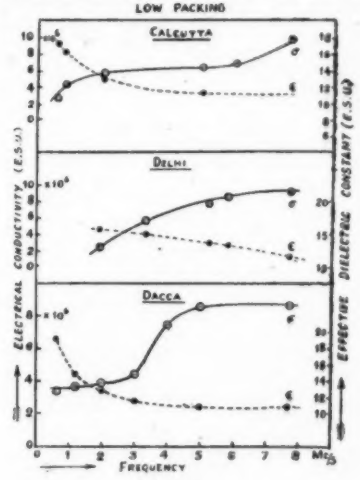

FIG. 1

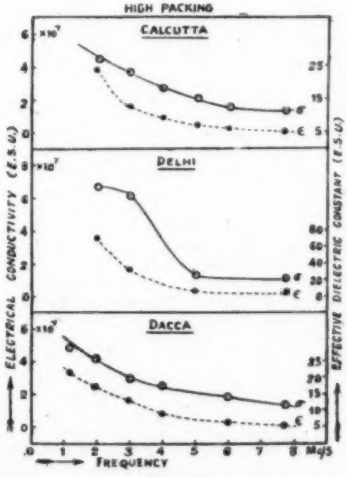

FIG. 2

The measurements of the soil constants were made by the oscillographic method over a

range of frequencies from 2 to 8 Mc./S. Fig. 1 refers to measurements with soils with a low packing, while Fig. 2 refers to a very high packing (4,500 lbs. per sq. inch). It is to be noted that the electrical conductivity of the soil, in the first case, increased with a frequency tending in some cases to a saturation value and that, in the second case, it decreased steadily with the increase of frequency. It can be said that the former illustrates the effect of dipolar molecules and the latter result is due to the preponderance of the skin effect at such high packing when the d.c. conductivity is, indeed, considerable. In both cases, however, the *effective* dielectric constant of the soil decreased with the increase of frequency over the range under investigation.

Dacca University,
Ramna, Dacca, S. R. KHASTGIR.
May 20, 1946.

1. White, *Proc. Camb. Phil. Soc.*, 1931, **27**. 2. Bairsto, *Proc. Roy. Soc.*, 1912, **A 96**, 363. 3. Unpublished work of Khastgir and Banerjee.

ON THE VISUAL LIGHT CURVE OF RT. ERIDANI

THE long-period variable RT. Eridani was first announced as variable in Harvard Circular 135, and the elements were derived by Zinner[1] based on observations made between the years 1912-1920 as

Max. J.D 2420060 + 380 days.

Miss Dwyer[2] from a study of Harvard plates taken between 1897 and 1928, an interval during which time she was able to obtain 27 maxima, finds an abrupt change in the period of this star since 1918. Her elements are

1897-1918 Max. J.D 2414900 + 366 days.
1918-1928 Max. J.D 2418562 + 378 days.

The star was on the regular variable star programme of the Nizamiah Observatory, Hyderabad, from 1924 onwards, and since then 242 observations were made till 1944, with the aid of the fifteen-inch Grubb Equatorial and three-inch finder. The elements derived from 4 fairly well observed maxima and 8 minima are

Max. J.D 2424217 + 368 days.

The period obtained from observations extending from 1924 to 1944 is thus 368 days. Taking into account Miss Dwyer's period of 378 days derived from the observations covering the interval 1918-1928, the variable seems to have recovered nearly its former period.

The individual light curves show that the maxima vary between 8·6 m. and 9·9 m., and that the minima are broader than the maxima; the minima also fluctuate between 12·2 m. and 12·8 m. The star therefore varies over a range of about four magnitudes.

The mean light curve (Fig. 1) indicates a hump on the way to maximum. The rate of ascent is greater than that of descent, the ratio of ascent to descent being 0·72. The star can therefore be considered to be of Type Cd (Campbell's classification of Long-Period Variables).[3]

The lack of observations on the descending branch is due to the fact that the period is nearly a year. By the time the variable reaches the maximum, its proximity to the sun, and later the onset of monsoons, prevent any observations being made on the descending branch, for this part of the period.

According to Miss Dwyer the interval between maximum phase to minimum phase is about 200 days. From an examination of the individual light curves of the variable, the

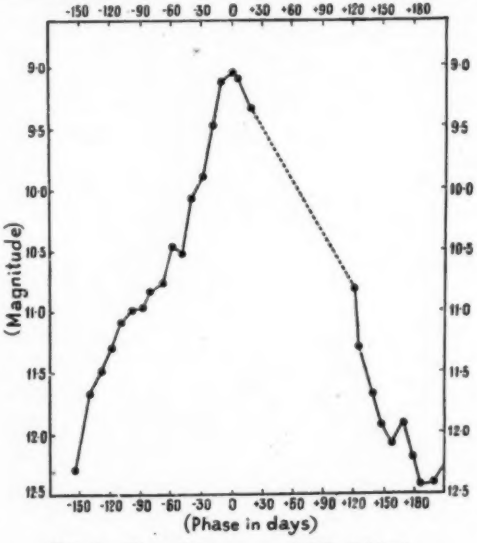

FIG. 1.—Mean light curves of RT. Eridani.

minima have been seen to follow the maxima roughly between 210 and 218 days. The humps in the light curves also fluctuate between 9·5 and 11·7 magnitudes. An interesting correlation has been noticed between the maximum magnitude of the hump and the corresponding maximum of the star, which is diagrammatically shown in Fig. 2.

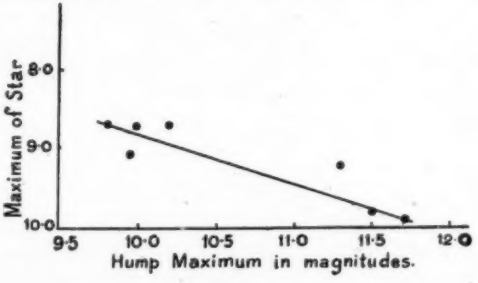

FIG. 2

Details regarding observations, etc., will be published elsewhere.

The author takes this opportunity to express his gratitude to Dr. Akbar Ali, Director, Nizamiah Observatory, for having kindly provided facilities and for his valuable guidance.

Begampet, Deccan, M. K. VAINU BAPPU.
June 4, 1946.

1. Zinner, *V.J.S.*, **51**, 260, 270. 2. Miss Dwyer, *Har. Bull.*, 868. 3. Campbell, H. A., 1907, **57**, 1.

RAIN FORMED IN LOW CLOUD MUCH WARMER THAN 0° C.

T. BERGERON,[1] while admitting that drizzle can occur from Cumulus clouds which are not high enough to be at 0° C. or less in temperature, believes that all rain-drops originate as snow-flakes or as ice-crystals, *i.e.*, are formed at much greater heights.

On the other hand, that rain-drops also form at much lesser heights, *i.e.*, without having been through a solid phase, at any rate in tropical and sub-tropical conditions, was well shewn by three light showers that occurred in Nagpur, lat. 21½° N., approximately, in the early hours of the 16th April 1946.

Associated with a weak and somewhat distant front, Stratocumulus clouds at an average height of about 3,000 feet above ground were slowly drifting from WSW to ENE. There was an almost full moon, which, therefore, between 3-30 and 4 hours, when the rain occurred, was fairly high in the heavens. One could see by it that the Stratocumulus cloudlets were of no great depth. Most of them had only the lightest shadows under them. Their depths may have been 500, certainly not more than 1,000 feet. And *above them the sky was clear.*

At least three light showers fell from these passing clouds, all consisting of medium-sized droplets; (no filter-paper impressions could be taken).

The amount of precipitation could not be measured. But it was sufficient to wet evenly a linen bed-sheet which covered me—I was sleeping in the open—and then just begin to drip through. An estimate of the amount would be 1 cent.

None of this rain could have originated above the freezing level, which at 07 hours was 11,000 feet a.s.l. All of it had obviously been formed in the shallow Stratocumulus layer and had dropped directly down from it. Clouding had commenced only a little while before. At 23 hrs. on 15th it was ·1 Cirrus, at 24 and 01 hrs. there were only traces of Stratocumulus, at 02, 03 and 04 hrs. ·7 Stratocumulus and ·2 to ·3 Altocumulus, and at 05 hours only ·4 Altocumulus. The pilot-balloon ascents nearest in time to this precipitation, *viz.*, of 00 and 07 hours, showed that at 00 hours the somewhat moister WSW current was not thicker than from surface upto 2,000 feet a.s.l., i.e., only 1,000 feet thick (Nagpur being 1,010 feet a.s.l.), the winds above that being 350°, 6 m.p.h. at 3,000, and 30°, 11 m.p.h. at 5,000 and 7,000 feet; whereas by 07 hours these upper winds had also become WSW-W upto about 6,000 feet. The latter were at 2,000 feet, 230°, 20 m.p.h.; at 3,000 feet, 240°, 15 m.p.h.; at 5,000 feet, 260°, 10 m.p.h.; at 7,000 feet, 310°, 5 m.p.h.; at 10,000 feet 330°, 11 m.p.h;, showing a remarkably smooth transition in both directions and speeds from a substantial WSW'ly (somewhat moist) current at the surface upwards to a N'ly (very dry) current from perhaps 6,500 feet a.s.l. upwards.

Thus it seems pretty evident that at half-time between these two observations, when the rain occurred, the upper limit of the WSW'ly air was at about 3,500 or 4,000 feet, *just where the Stratocumulus clouds had formed.*[2]

H. Köhler has shown from classical theory[3] that above a certain very low limit, cloud-droplets do not increase to larger sizes, or to raindrops, by condensation of more water-vapour on them—because with their curvature, vapour-pressure and reduced salinity on reaching those sizes, further condensation cannot take place on them—and that all growth thereafter to the sizes we are able to perceive as clouds is by *coalescence.* This has been found by me—from a few thousand measurements in monsoon clouds—to be entirely borne out, and I have been able to find additional groups of droplet-sizes (to the four groups found by Köhler in the clouds and fogs of Scandinavia and of Switzerland), and have found coalescence taking place actually *while* observations at short regular intervals were being made in a few clouds.

Rain-drop measurements also show these, or similar groups of sizes—though, of course, their sizes are all intrinsically very much larger.[4] Moreover, considerable time always elapses between the formation of a cloud and precipitation from it. There seems to be no reason, therefore, why rain-drops cannot also, like the larger cloud-droplets, be formed mainly by progressive coalescence of the latter under favourable conditions of convection, small eddies, electric charges, etc., within the clouds.

Regional Meteorological Centre, Nagpur, K. J. KABRAJI.
April 22, 1946.

1. *Report of the Lisbon Meeting of the International Union of Geodesy and Geophysics*, 1933, p. 166.
2. And that the mechanism of their formation was vertical waves created in the layer between the WSW'ly and N'ly airs.
3. H. Kohler. *Gerl. Beitr. z. Geophys.*, 1913, **29**, 2, 168–85; *Trans. Faraday Soc.*, 1936, **8**, 32. 1152–6.
4. Only if measured before loss by evaporation.

CHEMISTRY OF KURCHI SEEDS. PART III. A NEW AND SIMPLE METHOD OF ANALYSIS OF BROMOGLYCERIDES

THE isolation of the bromide of linoleo-dilinolenin from kurchi seed oil, recently reported in *Current Science*,[1] has raised the general question of the analysis of such bromoglycerides with special reference to the isomerism

of the constituent linolic and linolenic acids. It has been the practice so far among investigators in this field,[2,3] to debrominate the individual bromoglycerides to the corresponding unsaturated glycerides and rebrominating the unsaturated acids derived from them by hydrolysis, with a view to determine the nature and content of the individual unsaturated acids through identification of the bromo-derivatives. But it is well known that linolenic and linolic acids isomerise considerably on debromination and rebromination.[4] It seemed advisable, therefore, to devise a direct method of splitting the bromoglyceride into glycerine and the constituent bromo-acids. The present communication describes a successful attempt in this direction, applicable to the whole series of bromoglycerides derived from fats.

The first reagent tried for this purpose was a 4 N solution of aqueous hydrobromic acid which was, however, found unsuccessful. The second reagent which gave extraordinarily quantitative results was an 18 per cent. (by weight) solution of hydrogen bromide in glacial acetic acid specially prepared for the purpose.

0·2 G. of the bromide of linoleo-dilinolenin, m.p. 151°, obtained from kurchi seed oil,[1] was refluxed in an oil-bath with 7 c.c. of 4 N aqueous hydrobromic acid during three hours. The reaction product was diluted with water, filtered, the precipitate dried and washed with cold ether yielding 0·2 g. of product melting at 147-150° C., which proved to be the unchanged original substance.

In a second experiment 0·5 g. of the same bromide was digested at room temperature overnight with 5 c.c. of 18 per cent. hydrogen bromide in glacial acetic acid and then refluxed in an oil-bath during 1½ hours. The product worked up as before yielded 0·35 g. of a bromo-acid melting at 177-78° C., the melting point being unchanged on mixing with a pure specimen of α-linolenic acid hexabromide. The yield of the hexabromo-acid in the above hydrolysis is theoretical, confirming the original substance to be a pure linoleo-dilinolenin bromide.

The nature of the bromo-acid in the ethereal wash of the product and the exact mechanism of the splitting of the glycerine in this reaction are being studied.

Opportunity is hereby taken to correct an oversight in the theoretical bromine content of the bromide of linoleo-dilinolenin which should be 59·35 instead of 58·9 per cent. quoted in the previous communication.[1]

My thanks are due to Mr. P. Ramaswami Ayyar for suggesting the above methods and guiding the work and to Dr. P. C. Guha for kind interest.

Dept. of Pure & Appd. Chemistry,
Indian Institute of Science,
Bangalore, (Miss) R. J. Irani.
July 3, 1946.

1. *Curr. Sci.*, 1946, **15**, 161. 2. Vidyarthi and Mallya, *J. Ind. Chem. Soc.*, 1940, **17**, 87. 3. Singh and Kumar, *Proc. Ind. Acad. Sci.*, 1946, **23**, 379. 4. Erdmann and Bedford, *Ber.*, 1909, **42**, 1324.

NOTES ON *CORTICIUM ALBUM* DAST. AND *C. SALMONICOLOR* B. AND BR.

In 1940, a new Basidiomycetes on citrus stem was described by me and named as *Corticium album*. My colleague, Dr. B. B. Mundkur, has drawn my attention to Rogers' paper (1943) in which he says, "It appears highly probable that the fungus (*Corticium album* Dast.) is a member of the genus *Pellicularia*". Mundkur (1940) has shown that the name *C. album* is a later homonym of *C. album* Britz and so is untenable; he has also pointed out that as the new species lacks a Latin diagnosis it is to be considered as *nomen nudum*.

Being at the moment in a position to re-examine the slides and specimens of the type, the opportunity is taken of rectifying these mistakes and of seeing if the fungus is a *Pellicularia* Cooke.

Rogers (1935) from his study of the American species of *Corticium* found that they fall naturally into three groups which he has raised to specific ranks; the first group includes the most primitive of the holobasidiomycetes, for which group he proposes a new genus *Ceratobasidium*, the basidia of which can be divisible into hypo- and epibasidium; "the second group, exemplifying a further step in the evolution of holobasidial forms, constitutes the genus *Botryobasidium* Donk, characterised by its peculiar short-cylindric basidia closely resembling hyphal segments and by a unique hypochnoid fruiting layer"; the third group has urn-shaped basidia generally bearing five to eight spores.

Rogers (1943) pointed out that as the generic name *Pellicularia* Cooke, antedates *Botryobasidium* Donk, the former name has to be accepted in preference to the latter.

The fungus described by me evidently falls in the second group made by Rogers. He gives the following description of *Pellicularia*:— "Fructification resupinate, mucedinoid or hypochnoid, reticulate-pellicular, finely granulose under the lens more or less tufted, or even and loose-membranous; hyphæ strongly stainable in aniline blue, thick short-celled except for basal strands, branching at right angles and often with the formation of cruciform cells, the ascending hyphæ usually several times cymosely divided, bearing the terminal basidia in more or less candelabrum-like clusters, or in parasitic species sometimes relatively short and little divided; basidia subcylindric, not greatly exceeding in diameter the supporting cells, relatively short, bearing 4 or in several species 6-8 sterigmata; spores smooth-walled or rarely asperculate or spinulose, colorless or pale ochraceous; cystidia wanting, or present and of various forms."

The description given by me of the fungus on citrus stem fits in with the characteristics of *Pellicularia*. The fructification is resupinate; the basal layer consists of strands of long hyphæ without clamp connections and sparsely branched; above this layer is a tissue of cruciform cells, which are short, and from which arise terminal basidia in candelabrum-like structures; the basidia are clavate, and do not generally exceed in diameter the supporting

cells. The hyphæ of the material that has been preserved in rectified spirit and glycerine has been found to be distinctly stainable in aniline blue.

Unfortunately Rogers does not give the precise characteristics, of the genus *Corticium*, which should be used in its identification. If the grouping made by Rogers is accepted then the fungus under discussion clearly belongs to the second group, *viz.*, *Pellicularia*.

Rogers suggests that since the "basidia (of *Corticium album* Dast.) are longer than in most species of the genus and apparently distinctly clavate" they resemble those of *Pellicularia flavescens* (Bon.) Rogers com. nov. The basidia, however, are narrower than those of *P. flavescens* and the sterigmata and spores are also much smaller. The basidia and spores judging from the illustrations given by Rogers are entirely different from those observed by me (*cf.* Rogers, 1935, *Botryobasidium flavescens*, Pl. 2, Fig. 8; and Dastur, 1940, Pl. 1, Figs. 3-6).

If we consider the dimensions of basidia, sterigmata and basidiospores, the citrus fungus comes very near to *P. vaga* (Berk. and Curt.) Rogers ex Linder; the basidia of *P. vaga* are blunt-cylidric, and measure 13-22 (— 27) × 6·5-10 (— 15)μ; they bear rarely 4 or 5, mostly 6-8 stout, divergent, recurved sterigmata (3-) 4·5-6 × 1·5-2 μ; spores are smooth-walled, colourless, 7·5-12 (—17) × (2·5) 3·5-5 (—5·5) μ, fusoid, obliquely tapered to the apiculus. The basidia of four fungus are rounded at the apex, the sterigmata are invariably four and the spores are tapered to the apiculus but are rounded. The fructification of our fungus is distinctly snowy white when fresh and not "sordid whitish or pale buffy" as in *P. vaga*; for these reasons the citrus fungus is considered to be a new species and the new name *Pellicularia alba* is proposed.

Pellicularia alba sp. nov.

Fructificationes ad 30 cm. longæ. 10 cm. latæ, leves, lucido-albæ, tenues, resupinatæ atque adnatæ, margine plumoso; in sectione 70-300 μ crassæ, compositæ ex hyphis, hyalinis, sparse divisis, tenui pariete præditis, sparse septatis, parallellis, plus minus 3 μ in diam., compactia, longitudinaliter decurrentibus super substratum nec convolutis, producentibus latam seriem hypharum tenui pariete præditarum, laxe intertextarum, in ramulos divisarum, hyalinarum, cellulis brevibus, latis. Ex hos reticulato strato emergunt cellulæ basales, hyalinæ, tenui pariete præditæ, cylindricæ, 10·0-16·6 μ longæ, 3·3-6·6 μ latæ; ex his basalibus cellulis basidia terminaliter nonnumquam lateraliter, producuntur, hyalina, tenuiter parietata, clavata, 13·3-25·0 longa, 6·6-10·0 late in apice: sterigmata 4, brevia, hyalina, lata ad basim, tenuescentia ad apicam, 2·5-5·0 × 0·5-2·5 μ. Basidjosporæ hyalinæ, ovatæ, rotundæ in apica, acutæ ad basim, nonnumquam uno latere planæ, 8·3-10·3 × 3·3-5·0 μ. Gœocystidia absunt; hyphæ haud incurustratæ.

In cortice trucorum viventium *Citri aurantium*.

It would not be out of place here to consider the nomenclature of *Corticium salmonicolor* B. & Br. This fungus, at least the one studied by me (1941), is structurally a *Pellicularia*, as is evident from the detailed description and illustrations given by me. I have also examined the specimens labelled *Corticium salmonicolor* B. and Br. and available in the *Herb. Crypt. Ind. Orient.*, New Delhi, on *Hevea brasiliensis* (collected from Travancore in September 1909 and from Burma in July 1915), *Citrus* sp. (collected from Coorg in September 1942) and *Acacia arabica* (collected from the Punjab in August 1944). These specimens are all identical. Therefore, the name *C. salmonicolor* B. and Br. needs to be replaced by *Pellicularia salmonicolor* (B. and Br.) comb. nov.

My grateful thanks are due to my colleague, Dr. Mundkur, for not only giving the advantage of his vast knowledge of taxonomy but also for permitting me the use of his collection of books and periodicals; and to Rev. H. Santapau of St. Xavier's College, Bombay, for translating in Latin the diagnosis of *P. alba*.

Imperial Agri. Res. Institute,
New Delhi, J. F. DASTUR.
June 26, 1946.

1. Dastur, J. F., *Ind. Jour. Agr. Sc.*, 1940, **10**, 89-92. 2. — *Ibid.*, 1941, **11**, 892-901. 3. Mundkur, B. B., *Curr. Sci.*, 1940, **9**, 284. 4. Rogers, D. P., *Univ. Iowa. St. N. H.*, 1935, **17**, 1-43. 5. —, *Farlowia*, 1943, **1**, 95-118.

AN UNUSUAL MODE OF EGG-LAYING IN *SCHISTOCERCA GREGARIA* FORSK. AND ITS CAUSES

INTRODUCTION

FOR the first time in 1941 Lal observed an unusual mode of egg-laying in *Schistocerca gregaria* Forsk. In this case the eggs were laid on the surface and on the leaves of the trees, though usually they are laid four to six inches below the surface. My idea is that the locust begin laying eggs on the surface when they are unable to retain them. After fertilisation or even without fertilisation a stage comes when they cannot retain the eggs, if they find suitable places they lay eggs in the usual manner, otherwise they drop their eggs here and there indiscriminately and thus simply get rid of them. To ascertain the above-mentioned view the following experiments were performed.

EXPERIMENTS

Experiment No. 1.—A number of newly emerged adults were collected from a swarm, cut of which 24 males and 24 females were selected for the experiment. In one cage 12 female locusts were kept, after some time they changed their colour from pink to yellow and later on laid the eggs. These eggs were laid in the usual manner, i.e., after boring the holes in the moist sand which was kept in the cage. But none of those eggs developed further as no hoppers emerged. This shows that a time comes when a female locust cannot retain even unfertilised eggs.

Experiment No. 2.—In a cage a dozen locusts, *viz.*, six males and six females, were kept. These locusts after maturation copulated and laid eggs on the surface of the floor of the cage as there was no sand in the cage. These

eggs were laid indiscriminately on the surface. There was no egg-mass of more than six eggs. Some of these eggs were collected and were kept in moist sand, and they showed further development in the usual manner. But those eggs, which were left in the cage, died. This shows that after fertilisation there comes a time when the fertilised locusts cannot retain the eggs, they must lay whether the conditions for oviposition are suitable or not.

Experiment No. 3.—In a cage six pairs of locusts were kept; after maturation and copulation, the eggs were laid in the usual manner in the moist sand which was kept in the cage.

Experiment No. 4.—In a cage six pairs of locusts were kept, after maturation and copulation, the oviposition took place in the cage where there was only dry sand. After copulation the females began boring the sand but after each boring they used to leave the bore without laying eggs in it. Each female tried a number of times, when they did not find the conditions suitable they waited for two days more but later on they laid eggs on the surface of the sand.

Results

In all the four experiments the conditions were more or less similar. Where there was no moist sand the same humidity was maintained otherwise, the temperature was also more or less the same. All the locusts were given similar food. But the results were different. The egg-laying began first in the third cage, *i.e.*, where the conditions were absolutely normal, but the egg-laying was delayed by two days in the second and the fourth cage, *i.e.*, in the cages where conditions were not normal, *viz.*, either there was no sand or there was only dry sand. The egg-laying was further delayed by two days, *i.e.*, by four days as compared with the first case, in the case of unfertilised locusts. This shows that an unfertilised female can retain eggs for a longer period than a fertilised one. If the locusts do not find suitable places for egg-laying they can retain eggs for a longer period than those cases where they find suitable places, but later on they must lay eggs whether the place is suitable or not. If they do not find suitable place they leave the place after boring only without laying eggs in it.

The observations in the natural conditions also support the above-mentioned views. So far the unusual mode of egg-laying has been observed at only three places in India, *viz.*, in the eastern part of Jaipur State, Alwar State and the western part of the United Provinces. All these places are almost the extreme limits of the eastern part of the area upto which the oviposition generally takes place. When the swarms migrate from the north-west of India they are immature and fly eastwards. As they fly further and further they become matured, in the way they settle down and copulate, and if the place is suitable they lay eggs then and there, but if they do not find any suitable place in Sind, Jaisalmer State, Jodhpur State or even in the western part of Jaipur State they migrate further, by that time a stage is reached when they cannot retain the eggs any longer and therefore begin laying eggs whether the place is suitable or not. By that time they feel so uncomfortable that they want to get rid of their eggs, and thus they drop their eggs on the surface of the ground or on the leaves of the trees. It may be noted here that this phenomenon of unusual mode of egg-laying is generally observed in the beginning of the monsoon season when there are not sufficient rains in the Jaisalmer and Jodhpur States.

Summary and Conclusions

A time comes when the locusts are unable to retain eggs whether they are fertilised or not, in such cases they begin laying eggs on the surface indiscriminately, so as to get rid of their eggs, perhaps because they feel very uncomfortable.

At the time of egg-laying they bore in the ground, if there is no moisture they leave the bore without laying eggs in it, and lay the eggs on the surface.

Lal's contention is that the locusts do not bore the ground but lay eggs on the surface on account of the extreme dryness of the ground. But my observations show that the extreme dryness of the ground is not the only cause but their inability to retain the eggs inside forces them to lay the eggs anywhere indiscriminately.

Agricultural Research Labs.,
Gwalior, R. Rakshpal.
April 23, 1946.

1. Lal, K. B., *Indian J. Ent.*, 1941, **3**.

POST-EMBRYONIC DEVELOPMENT OF ANTENNA OF *BAGRADA PICTA* FAB.

Almost all the members of the family pentatomidæ (Hemiptera-Heteroptera) possess five-jointed antennæ; similarly *Bagrada picta* Fab. also has five-jointed antennæ in the adult stage. But during the nymphal stages the antennæ remain four-jointed. Each antenna is long, filamentous, mobile and filiform. All the segments of the antenna are provided with bristles except the scape.

Just after hatching the first nymph stage has the four-jointed antenna. The scape is the smallest and is about 0·075 mm. long. The pedicel is about 0·12 mm. long and is shorter than the other two segments of the flagellum —the penultimate and ultimate, the latter is longer than the former and they are about 0·20 mm. and 0·23 mm. long respectively. Thus at this stage the arrangement of the antennal segments is such that the proximal segment is smallest and they elongate as the distal end is approached.

After the first moult the antenna becomes elongated but remains four-jointed. The scape remains smallest and is about 0·1 mm. long, while the pedicel elongates, becomes more or less equal to the penultimate segment but smaller than the ultimate and is about 0·22 mm. long. The penultimate and ultimate segments of the antenna also increase in length and are about 0·25 mm. and 0·37 mm. long respectively. The arrangement of the antennal segments remain more or less the same as in the first stage.

In the third stage nymph the antenna is still four-jointed. The scape remains the smallest and is about 0·12 mm. long. The pedicel grows further, becomes longer than the penultimate segment but remains smaller than the ultimate and they are about 0·4 mm., 0·3 mm. and 0·5 mm. long respectively.

In the fourth stage nymph the antenna continues to elongate but is still four-jointed. The scape remains smallest and is about 0·21 mm. long. The pedicel further elongates, becomes almost equal to the ultimate segment and is about 0·58 mm. long. The penultimate and ultimate segments grow further and are about 0·48 mm. and 0·6 mm. long respectively.

In the fifth stage nymph the antenna further elongates but remains four-jointed. The scape continues to remain smallest and is about 0·22 mm. long. The pedicel increases in length so much that it becomes the longest segment of the antenna and is about 0·85 mm. long. The ultimate segment is longer than the penultimate and they are about 0·72 mm. and 0·65 mm. long respectively. It may be noted here that the pedicel, which was the next smallest segment of the antenna in the first nymph stage, now becomes the longest segment.

In the adult stage the antenna, which remained four-jointed throughout the nymphal stages, now becomes five-jointed. The scape is the smallest and is about 0·22 mm. long. The pedicel is about 0·67 mm. long. The newly appeared third segment is about 0·47 mm. long. It appears that the pedicel has been divided into two segments and thus the antenna becomes five-jointed. The penultimate and ultimate segments are about 0·65 mm. and 0·67 mm. long respectively.

Conclusion

It has been shown that during the nymphal stages the pedicel continues to elongate much more rapidly than other segments of the antenna, but in the adult stage it becomes shortened, while other segments continue to elongate as in the previous stages. The natural inference would be that the pedicel becomes divided into two segments and thus becomes shortened. In fact it actually happens, *viz.*, a new segment appears in the adult stage and thus the antenna becomes five-jointed which was so far four-jointed.

Hence it may be concluded that in *B. picta* Fab., it is the pedicel only which divides and thus a new segment is added to the antenna.

Now it can be generalised that wherever there is an increase in the antennal segment it is only the pedicel which divides.

I am very much thankful to Dr. R. Rakshpal, Entomologist, Agricultural Research Laboratories, Gwalior, for his kind help in connection with this work.

Dept. of Zoology,
Victoria College,
Lashkar,
Gwalior State,
June 6, 1946.

Shiva Sahai Saxena.

Table showing the length of the different segments of Antenna of Bagrada picta *Fab. during the nymph and adult stages*

Nymyh Stage	Length of scape	Length of pedicel		Length of penultimate	Length of ultimate	Total length	Remarks
1	0·075 mm.	0·12 mm.		0·20 mm.	0·23 mm.	0·62 mm.	4–jointed
2	0·1 ,,	0·22 ,,		0·25 ,,	0·37 ,,	0·94 ,,	4 ,,
3	0·12 ,,	0·4 ,,		0·3 ,,	0·5 ,,	1·3 ,,	4 ,,
4	0·21 ,,	0·58 ,,		0·48 ,,	0·6 ,,	1·87 ,,	4 ,,
5	0·22 ,,	0·85 ,,		0·65 ,,	0·72 ,,	2·44 ,,	4 ,,
6 *a*	0·22 ,,	0·67 ,,	0·47 mm	0·65 ,,	0·67 ,,	2·68 ,,	4 ,,
6 *b*	0·37 ,,	0·48 ,,	0·54 ,,	0·65 ,,	0·77 ,,	3·01 ,,	4 ,,

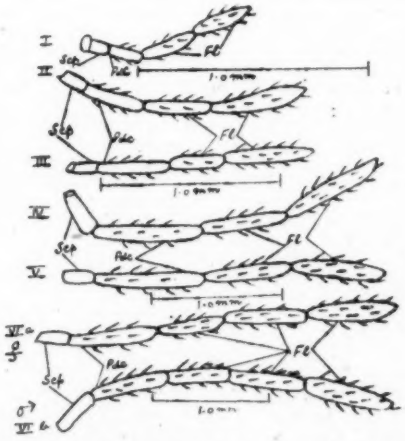

FIG. 1.—Antennæ of different nymphal stages of *Bagrada picta* Fab. I–V, Antennæ of nymphal stages; VI *a*, Antenna of adult female; VI *b*, Antenna of adult male; *Fl.*, flagellum, *Pdc.*, pedicel; *Scp.*, scape.

PYTHIUM COLLAR-ROT OF FIELD PEA AT CAWNPORE, UNITED PROVINCES

No species of *Pythium* has so far been recorded from India or abroad except once by Wittmack[1] who found in the decaying roots of peas sent to him by Sadeback from Hamburg, Germany, oospores apparently belonging to a

new *Pythium*, which he called *P. Sadebeckianum.*

On 19th February 1946 the writer, while examining the pea-plots in the Research Farm, Cawnpore, observed a few scattered full-grown pea plants, presenting unhealthy appearance with most of their lower leaves yellowed out and dying; a condition unlike the effect of frost in which case leaves start dying from the top downwards. In some cases the pea plants had fruited. The examination of the collar of plants showed the presence of light-brown to dark-brown soft and water-soaked lesions. A large number of isolations were made and invariably in 90 per cent. cases a species of *Pythium* was obtained which readily formed fructifications (antheridia, oogonia and oospores) within a week on potato-dextrose agar at the room temperature ranging from 21° C. to 23° C. On 27th February 1946, the writer found in the dairy farm, Cawnpore, patches of diseased pea plants with pods in low-lying water-logged portions of the field. Here many of the pea plants were dead and some half dead; but all showed invariably the light-brown to dark-brown soft, water-soaked lesions on the collar. The same species of *Pythium* was isolated from a number of plants although in few cases (5 to 10 per cent.) a *Fusarium* sp. was also isolated. Preliminary pathogenicity experiments with pea seedlings in pots to establish the cause of the disease were carried out and it was found that pea seedlings (6-8 inches high) start dying with similar typical symptoms as observed in the field from fifth day onwards and by fourteen days all died, while controls remain unaffected. The room temperature ranged from 30° C. to 37° C. The fungus was reisolated from artificially inoculated dead pea plants. This species of *Pythium* forms zoosporangia and zoospores at the room temperature of 27° C. to 32° C. in light within 48 hours in distilled water. How zoospores emerge out from zoosporangia has not so far been observed. Further studies are continuing.

Plant Pathologist to
Government of U.P.,
Cawnpore,
May 24, 1945. U. B. SINGH.

*1. Wittmack, L. "Ueber Eine Durch pythium veranlasste Ekrankheit der Erbsenwurzeln," Paper presented at 64. Versamml. Zu. Halle, *Gesell. Deut. Naturf. u. Aerzte*, Sept. 1891. Not published. Title in Verhandlungen 2: 108, 1892.

N.B.—Since the writing of this note the writer has come across a record of pea blight probably caused by *Pythium debaryanum* by Jones. Jones, F. R. (1920) 'Pythium as a casual factor in 'Peablight'," *Phytopath.* **10**, 67.

EFFECT OF NA-SUPHAPYRIDINE ON THE CATALASE ACTIVITY OF RICE SEEDS

THE use of sulpha-drugs for the treatment of human diseases is well known and their action on the different physiological activities of the human body is under investigation by a number of workers. But the action of these synthetic drugs on plants has been little investigated. This note is the outcome of an attempt to study the effect of Na-sulphapyridine (M.B. 693—water-soluble) on the germination percentage and catalase activity of rice seeds.

Rice seeds of the variety D.1.4, supplied by the Cuttack Farm, were used in this work. For the germination study, 100 seeds were soaked in solutions of the different concentrations of the drug (1 per cent., ·1 per cent., ·01 per cent. and ·001 per cent.) and distilled water in petri-dishes. The dishes were kept in a moist chamber to guard against any rapid change in the concentration of the solutions. The solutions and the distilled water of the dishes were changed twice daily. For the determination of the catalase activity, the same arrangements were made except that 25 gms. of the air-dry seeds were used instead of 100 seeds.

The germination counts were made in the afternoon daily, and the values are expressed on a percentage basis. For the determination of the catalase activity, 1 gm. of the soaked seeds was taken and was macerated with 3 gms. of calcium carbonate. The pulverising process continued up to 3 minutes and next the mass made to 20 c.c. by the addition of the distilled water. The catalase activity is represented by the amount of oxygen liberated in each case in an unit time of 5 minutes. The apparatus and the experimental details were the same as advocated by Davis[1] and Miller.[2] The results are presented in the table.

TABLE

Time		Treatments				
		Distilled water	Conc. of Na-Sulphapyridine			
			·001%	·01%	·1%	·1%
36 hours after soaking	Germination %	27	50	29	29	15
	Catalase activity	9·5	14·5	12·5	9·6	9·6
60 hours after soaking	Germination %	59	60	68	32	15
	Catalase activity	11·5	17·0	14·0	12·5	10·0
84 hours after soaking	Germination %	88	97	68	40	15
	Catalase activity	14·0	21·0	20·7	9·6	9·0
108 hours after soaking	Germination %	88	97	72	40	15
	Catalase activity	16·0	21·0	22·0	11·0	8·0

An analysis of the results indicate that the drug in weak concentration has a stimulating action on the germination percentage and cata-

lase activity but with the increase in the concentration, there is a marked retardation. The results are preliminary and hardly any general conclusions can be drawn. Investigation in this line is in progress.

The author is grateful to Dr. Mishra, Head of the Botany Department, for his keen interest and for the facilities provided.

Botany Laboratory,
Ravenshaw College, SHYAMANANDA PATTANAIK.
Cuttack,
May 5, 1946.

1. Davis, W. E., "The use of catalase as a means of determining the viability of seeds," *Proc. 18th Ann. Meeting Assoc. of Seed Analysts*, 1925, N. A. 6–12. 2. Miller, E. C., *Plant Physiology* (Second Edition, 1938), McGraw- Hill Book Company.

D.D.T. AND OX WARBLE CONTROL

BECAUSE of the acute derris shortage consequent upon the recent war, investigations were conducted to find a substitute to be used in ox warble control. In conformation with the usual practice, D.D.T. at concentrations of 0·5, 1·0 and 5·0 per cent. both in turpentine oil and in emulsion with kerosene oil and liquid soap, was sprayed on different batches of cattle during the warble-fly egg-laying season (March-June). These animals when examined for warble tumours during October to January showed infestation to the extent of 40 to 50 per cent. in each batch. This is about the normal percentage of infestation in the locality concerned. It would thus indicate that D.D.T. failed to act as an ovicide or a fly repellent for ox warble control.

Second attempt was made during the warble tumour season (October-January). D.D.T. in solution with turpentine oil at concentrations of 0·5, 1·0 and 5·0 per cent. was rubbed on full-grown warble tumours. Three days later the cattle were carefully inspected and none of the larvæ treated was killed.

Both these trials have conclusively shown that D.D.T. is ineffective against ox warbles. This unusual ineffectiveness of the drug could perhaps be attributed to the fact that D.D.T. being only a stomach and a contact poison for insects could neither bring about the desired effect to repel the adult warble-fly when used as a preventive nor could it kill the larvæ by acting as a respiratory poison when dressed over warble tumours.

Stewart (1944) while conducting experiments in U.S.A. for the control of ox warbles with D.D.T. has experienced similar results.

My grateful thanks are due to Dr. F. C. Minett for his advice and encouragement during the progress of this investigation.

This work has been carried out as a part of a scheme of research financed by the Imperial Council of Agricultural Research. The generosity of the Council is gratefully acknowledged.

Veterinary Zoology Section,
Imp. Vet. Research Institute, B. N. SONI.
Mukteswar (Kumaun),
March 15, 1946.

1. Stewart, M. A., *Jour. Econ. Ent.*, 1944, **37**, 756.

COLOUR DIMORPHISM IN *CERIOCOCCUS HIBISCI* GREEN

COMSTOCK discovered a new genus of wax-producing scale insects which he named *Cerococcus*. Green found a new insect which he classed under this genus and named it *Cerococcus hibisci*. This insect is also mentioned and illustrated by Ramakrishna Ayyar,[1] with Green's nomenclature, so that he naturally concurs with Green's classification. Ramakrishna Ayyar does not mention Green's *C. ornatus* which is commonly found in Bangalore. Upon the latter insect I have published[2] a short communication already. Both these species, *ornatus* and *hibisci*, do not secrete wax. On the contrary their scale consists of a leather-like product, insoluble in all fat solvents, quite unlike wax. Green kindly sent a specimen of an insect belonging to Comstock's genus, *Cerococcus*, which had genuine wax. A new genus has been already[2] created, *Coriococcus* which must now include *Coriococcus ornatus* and *C. hibisci*.

The wax-producing scale insects show the presence of yeast-like symbiotes. This is true of the genera *Ceroplastes*, *Ceroplastodes* and *Vinsonia*, which are all represented at Bangalore. The Chinese wax insect, *Ericerus pela*, which were examined histologically, also show yeasts. Unlike the above wax insects, *C. hibisci* and *C. ornatus* contain bacteria thus further differing from wax insects as a class.

Coricoccus hibisci has two forms, differing only in colour. In this respect it is similar to the lac insect of Kashmir, *Lakshadia ficii*, already illustrated[3] and *L. albizziæ*, where also red and yellow forms are found. The one form of the *C. hibisci*, found on a wild plant of the genus Malvaceæ, at Bangalore, has the colour of burnt sienna. Its male is bright carmine coloured. The other form is greenish yellow, comparable with the yellow chrome as manufactured by Winsor and Newton. During the period of eight years at Bangalore only twice was the yellow form discovered on a weed of the genus Labiaceæ. The male is dirty brown, quite different in colour from the red male of the other form. Ramakrishna Ayyar mentions that *C. hibisci* "is popularly known as the yellow scale of the cotton as the scale have a pale yellow colour", without mentioning the existence of a reddish form. When he was the Government Entomologist here, Dr. B. P. Naidu, at my initiative, sent him yellow forms which he kindly identified as *C. hibisci*. Subsequently the reddish forms were submitted but so far has brought no reply; evidently he was unaware of the existence of colour dimorphism and did not risk identifying an insect unknown to him.

At Hyderabad, and in the city of Bombay, I have found this insect on *Hibiscus rosa sinensis*, most often as mixed colonies. In this city a pure colony of red forms was found only on a few occasions; far more common was the case with the pure yellow form.

It would appear that the red form is the original wild form from which a yellow mutant has arisen as a result of facilities in propagation. In the mixed colonies the red form is usually the more predominant but on

rare occasions the opposite has also been found. It is still unsolved if the red and yellow insect revert each to its opposite form. Experiments were carried out with the Kashmir lac insect which went to indicate such a transformation. Breeding experiments with pure and mixed brood have established that the progeny keeps true to the parents for one generation and under ordinary condition, but that physiological transformation of colour takes place must be self-evident.

The symbiotic bacterium of *C. ornatus* in culture produces a pale blue colour which changed to a bright red pigment as the culture becomes old; the skin of the insect is pale blue while its scale is red. It appears that the bacterium produces these two pigments, the red being formed as oxidation proceeds. With *C. hibisci* the symbiotes of both the forms microscopically appear identical. At Bangalore, where the yellow form of *C. hibisci* was not available, I had to content myself with studies on its red form. Its bacterium in fresh culture produces a yellow colour which darkens to burnt sienna, identical with the colour of the scale. In the case of the yellow and red lac insects none of them have any chromogenic symbiotes and it appears that the insects synthesise the dyes from products elaborated by the yeast-like symbiote. With *C. hibisci* either the yellow insect has a bacterium which is physiologically different or more likely the insect body prevents any further oxidation of the yellow pigment. It is proposed to isolate the bacterium of the yellow form which will throw light on the above problem.

Osmania Medical College,
Hyderabad (Dn.), S. MAHDIHASSAN.
June 25, 1946.

1. "South Indian Coccidæ," *Imp. Inst. of Agri. Res. Btn.*, 1929, 197. 2. *C. R. Acad. Sci., Paris.*, **196**, 560. 3. *Archiv. J. Protist.*, 1929, **68**, Plate 17, Fig. 3.

NUCLEAR REORGANIZATION IN *EPISTYLIS*

DILLER[1] first announunced in *Paramœcium aurelia* the occurrence of a "purely asexual reorganization process" in which only the macronucleus was involved. He later[2] extended his observations and established that in this ciliate, in addition to conjugation and autogamy, a periodical change occurred in the macro-nucleus resulting in the extrusion of small bodies from it or in its total fragmentation. To this process he applied the term "Hemixis", and though its role in life-cycle, its relationship with conjugation and autogamy and its genetic effects are still to be studied, it was clear that hemixis occurred as a part of the normal life-cycle of the organism. So far this interesting phenomenon has been described only in *Paramœcium*.

It was, therefore, a matter of considerable interest to come across this process in another ciliate *Epistylis* (*Peritricha*: *Epistylidæ*). While investigating the cytology of 3 species of this genus, *E. plicatilis*, *E. anastatica* and *E. articulata*, it was discovered that hemixis was a very common phenomenon in all the species. All the three types of hemixis described by Diller[2] in *Paramœcium aurelia* were noticed: (*a*) extrusion of small spherical fragments from the macronucleus, (*b*) splitting of the macronucleus into large independent portions, and (*c*) total fragmentation of the macronucleus. But by far the most common was the

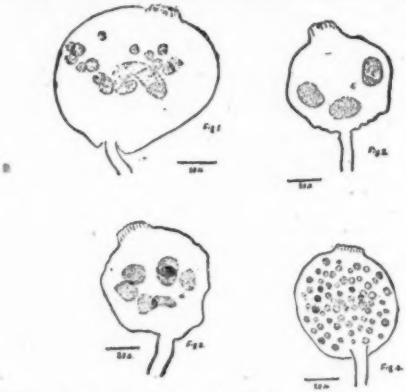

FIG. 1. *E. anastatica*, illustrating hemixis, type *a*; the macronucleus is extruding small spherical fragments.

FIGS. 2 and 3. *E. plicatilis*, illustrating hemixis, type *b*; in Fig. 2, the macronucleus has split into three fragments and in Fig. 3, it has split into seven fragments.

FIG. 4. *E. plicatilis*, illustrating hemixis, type *c*; the macronucleus has fragmented into numerous small bodies.

last type involving the fragmentation of the macronucleus into an incredibly large number of minute spherical bodies.*

The details of the process will be published elsewhere.

Department of Zoology,
University of Mysore,
Central College, B. R. SESHACHAR.
Bangalore,
July 6, 1946.

1. Diller, W. F., *Science*, 1934, **79**, 57. 2. —, *J. Morph.*, 1936, **59**, 11.

* The author wishes to thank Mr. S. C. Pillai, Department of Biochemistry, Indian Institute of Science, Bangalore, for placing a large quantity of material at his disposal.

PEACEFUL V-2 ROCKETS

GERMAN V-2 rockets are being fired in New Mexico. Their warheads, which formerly contained the explosive charge, are now being equipped with apparatus for the measurement of cosmic-ray intensities at altitudes as high as 100 miles above sea-level.

B-29 bombers, also, are collaborating in cosmic-ray studies—flying at altitudes of 35,000 feet between the northern United States and the magnetic equator. The range in latitude is important because of the variation of cosmic-ray intensity with distance from the equator.

—Courtesy of *Sky and Telescope*, 1946, 5, 10.

REVIEWS

Major Instruments of Science and Their Applications to Chemistry. (Inter-Science Publications, Inc., New York, N.Y.), 1945. Pp. 147. Price $3.50.

Amongst the outstanding developments in Physical Science, some of the most remarkable have originated in the interface, Physics/Chemistry. To the rapidly growing body of knowledge in this borderland, the present monograph is a valuable addition. Its various sections, contributed by specialists, refer to Electron Diffraction; X-Rays; and Chemical Spectroscopy, including especially the infrared. The fundamental theory, experimental technique and practical uses of each of these topics are explained with precision and lucidity. From its discovery as a universal particle to a knowledge of its wave nature, the electron has played a unique role; of interest, not only from the theoretical standpoint, but also for the practical applications. Compared with X-rays, the electrons have remarkably low penetrability, *viz.*, 500 Å and 2,000 Å for a gold and magnesium film respectively, for 50 kV electrons. An X-ray pattern is produced by the body of a block; that due to electrons reveals its surface structure. This provides a powerful means for a study of films too thin for spectroscopic analysis and in "microchemical" amounts; so called mono- and multilayers and catalyst surfaces. That, of the 700 recent publications over 300 are contributed by workers in industrial laboratories, in U.S.A., is significant.

The least distance, distinguishable optically, depends chiefly on the wave-length. This last, for the electrons for large enough working voltages, turns out to be 100,000 times smaller than that of the visible light, and leads to over 100-fold increase of useful magnification in the electron microscope. Its constructional details, optimum working conditions and some peculiar limitations of electron optics, *e.g.*, aberration, are set forth. In an electron microscope the image is produced not by absorption or refraction, but by scattering by atoms in the specimen. This is roughly proportional to its thickness and density. With 60 to 80 kV electrons, 0·5 micron would appear to be a limiting thickness for organic materials for obtaining the electron micrographs. Striking results are obtained with colloids; clay particles; metallic smokes; 'latent image' of the photographic plate; elementary fibres in plastics and rubber; soap films; bacteria and viruses; thus *e.g.*, the tobacco mosaic virus is found to be about 3,000 Å and 150 Å in diameter.

The section on X-rays deals with various methods of obtaining characteristic patterns; methods for the structure determination of not only crystals but of such systems as rubber, gelatin, gutta percha; alloys, eutectoides and solid solutions, with typical results for the influence of stretching and annealing. An account is given of methods for the determination of electron densities at various positions of a unit cell. The resulting contour maps, showing the projections of the atoms in the cell "are nearest approach to direct photography of atoms and molecules".

Despite well-known treatises on spectroscopy the last three sections are undoubtedly a welcome addition. Within a compass of 80 pages the authors have presented critically and markedly lucidly, fundamental concepts in the spectroscopic analysis; its wide range of uses and likely developments. The inclusion of a careful selection of numerous tables of standard data and description of procedures for precise evaluation of basic experimental quantities, such as, for example, the intensity of lines, makes this part of the book valuable alike to a research worker and one interested in spectroscopy as an aid to the chemical theory.

S. S. Joshi.

Spectacle Lenses. By P. Hariharan, Trivandrum. (1946.) Pp. 110. Price Rs. 10.

The major portion of the book under review is on the subject of spectacle lenses but the author quite naturally leads on, in the final chapter, to more advanced optical work such as magnifiers, eyepiece lenses, and small achromatic objectives. The author starts from very elementary considerations both as regards the theory and the practice of manufacture of spectacle lenses purely by hand work. He ultimately ends with the making of these spectacle lenses by machine work, and in batches, comprising considerable numbers going under the name of the 'block system'. The design of the machines used in the manufacture of these spectacle lenses, is such that they can not only be fabricated from local materials with the craftsmanship available, but also could be later used for more advanced optical work. Special mention should be made of Chapter VIII on "Simple Devices to Help Production", where the usual standard designs are cleverly modified for home production. In the concluding chapter on "Advanced Optical Work", the author indicates in a general way the methods followed in the manufacture of telescope objectives, both reflectors and refractors, and also of precision optical flats that are used for testing purposes in the optical workshop and laboratory. Complete details of computation and manufacture are, however, proposed to be dealt with in another monograph on the subject.

A serious handicap to the development of the optical industry is the lack of glass of optical quality and also the availability of suitable abrasives. The latter disadvantage is not, however, so great since there are many naturally occurring abrasives, such as those mentioned by the author, and the industrial abrasives like carborundum can be manufactured in this country. Regarding optical glass the technical knowledge and experience required in its manufacture, and the financial commitments involved are very great.

The contents of the above book formed the subject of a thesis that was awarded the H. H. the Maharani Setu Parvati Bayi Prize for 1944, by the Travancore Government. The young author, who is the son of Dr. H. Parameswaran, Director of Industries in Travancore, and a pioneer in this country in the working of optical glass parts, deserves to be warmly congratulated for the commendable way in which he has got up his thesis into book form with appropriate line-drawings and halftone blocks.

R. M. Row.

Chemical Indusrty in India. A.I.M.O. Monograph No. 7. Bombay, 1945. Price Rs. 5-12.

The trend towards economic self-sufficiency has grown with increasing pace, and in this economy of every country, chemical industries occupy a unique position. It is, therefore, but opportune that the All-India Manufacturers' Organization should have, with considerable effort collected and published statistical and other informations to the extent available, regarding chemical industries in India.

This Monograph of 250 pages, consists essentially of five chapters on general surveys covering 80 pages, while the rest of the book is devoted to various tabulated details regarding distribution of chemical establishments in India, trade statistics, and a bibliography of technical publications. In Chapter II, there is a survey of the development of chemical manufactures in India, and the contributions to the same by the opportunities provided by the war. Chapter V, on "Notes on Chemicals", deals with specific essential chemical industries like the manufacture of sulphuric acid, soda ash, caustic soda, fertilisers, dyestuffs, etc., and gives concise notes on their present position and future possibilities.

This Monograph should prove to be quite a useful book of reference to all interested in chemical industries. However, Appendix I on the Chemical Establishments in India, would have been more useful and less misleading if care had been exercised in selecting the addresses for inclusion in the list. Besides prominent omissions, there are addresses which tend to give a wrong impression of the development of chemical industries in the area. The other Appendices on Exports and Imports are very informative.

M. A. G.

Trees in Britain. By L. J. F. Brimble. (Macmillan and Company, Limited, London), 1946. Pp. x + 352. 15*sh.* net.

Those who are acquainted with the author's book on *Flowers in Britain* would find in the present work a companion volume to it. Some of the trees dealt with in greater detail in the present volume were briefly described in the book on flowers. Many of the trees now described could not have found a place in the volume on flowers. In view of the importance of trees, the necessity for a separate volume on trees cannot, therefore, be considered as superfluous. The present volume on trees fills up a gap which would otherwise have remained unfilled.

The scope, arrangement and the presentation of the subject-matter of the book are on lines similar to those found in the author's companion volume on flowers. The author has written the book on trees as he did the one on flowers, not so much for the professional botanist, but more to cater to the interests of the much wider circle of readers represented by the laymen and plant lovers. Persons little acquainted with the science of botany would find it easy to understand the book as would those conversant with plant science. A perusal of the book would show that there is much more to learn about the trees than what is commonly known about them by those who are familiar with them.

The introductory part of the book is specially meant to help the reader to understand the basic principles underlying the broad groupings into which plants have been classified. The chapter on classification of plants explains in easy terms the principles of plant systematics. The author's advice that plants cannot be studied from books alone but that they must be studied in their habitat by rambling through woods and meadows is a very important one and cannot be over-emphasised. This should specially be borne in mind by all those who are concerned with the teaching of botany in schools and colleges.

The important trees of Britain belong to the cone-bearing and the seed-bearing types. The chief among these two groups such as the pines, firs, cedars, cypresses and the yews, the oak, birch, beech, willow, walnut and many others are all described not merely from the botanical or utilitarian point of view but also with reference to historical anecdotes or appropriate verses.

Although the book does not fully exhaust the list of trees of Britain, yet a great many of them have been well described. Considering the quick succession in which the two volumes on flowers and trees have been issued and the popularity which the volume on flowers has gained, it must be admitted that the average Westerner is a better lover of plants and greater appreciator of Nature's beauty than is his Indian confrère. The sense of appreciation of the beauty in Nature has to be cultivated in the people of this country and this can only be done if this sense is developed and trained in school children. Towards such an end books of the type written by Brimble on flowers and trees would be very helpful. The volume on *Flowers in Britain* and *Trees in Britain* should be included in the library of every school and college in this country.

The beautiful coloured plates, the photographs and the author's line-drawings—all contribute much to the value of the book. The get-up is attractive and would appeal to many. The book should become very popular.

L. S. S. Kumar.

The Tanner.—*A Monthly.* Edited by Sri. S. Raja, "Jer Mansion", Bandra, Bombay.

The tanning of leather which a decade ago was mainly an empirical trade has, in recent

years, grown into a highly specialised scientific industry. India has never in the past been able to keep pace with the rapid development of the scientific industries of Europe and America but a new era of industrial progress is approaching and as one of the largest producers of raw hides and skins in the world, India possesses unique opportunities for the scientific advancement of her Tanning Industry.

We, therefore, welcome with much pleasure, the advent of *The Tanner*, a Bombay Monthly, devoted to the tanning and allied trades. The Journal is edited by Mr. S. Raja who, with his large and varied experience of the industry, has excellent opportunities for helping its scientific development.

The initial issue of *The Tanner* mainly emphasises the "trade" aspect of the industry. Rightly or wrongly, the speedy advancement of any branch of scientific research seems to depend on the well-being of the "trade" to which it relates and it is, therefore, in the fitness of things that a trade journal like *The Tanner* should primarily cater to the "business" side of the industry.

The first issue reproduces two articles of particular importance to the Tanning Industry. Sir Ernest Bevin, in his article "Planned Stagnation", complains of the evils of bureaucratic interference with the normal functioning of business in England. Mr. Humayun Abdulali tells us of the bungling of the Government of India in respect of India's raw hide trade during the period of war. It is characteristic of Governmental attitude that the Director of Tanning and Footwear, who must be held primarily responsible for the raw hide muddle, seeks to shift the blame on to the members of the Tanning Industry for their want of mutual co-operation!

All these post-mortem wails of wrongs done and evils established might have been avoided if opportunities for timely criticism had been freely available to all the members of the trade through the medium of a recognised trade journal. Luckily we have at last finished with the vagaries of war-time "Controllers" and "Directors" but even in a Free India the "*Pundits*" of post-war planning may, in all good faith, place hurdles in the path of progress unless every view-point is openly discussed and unbiassed decisions arrived at. It is in this respect that a trade journal can best serve the interests it represents and we wish *The Tanner* a long life of service in the cause of the Indian Tanning Industry.

G. R.

Melanchthon—Alien or Ally? By Franz Hildebrandt. (University Press, Cambridge), 1946. Pp. 98. 8*sh.* 6*d.* net.

While the whole civilized world to-day is profoundly preoccupied with the task of unravelling the mysteries of the Atomic bomb, a single and solitary use of which suddenly and precipitately brought about the end of Japanese sovereignty, it must be deeply interesting and intriguing to note that scholars and thinkers like Dr. Hildebrandt, "pastor and lecturer in Cambridge", should be found engaged in a discussion of theological problems relating to the spiritual friendship between Luther and Melanchthon which at first sight must seem removed far from the scientific pursuits grounded on laboratory methodology and verification, and *pro tanto* unprofitable and valueless. Be that as it may, the volume under notice makes a distinctive and striking contribution to a clear understanding of certain aspects, doctrines, and settings relating to the general dogmatics of Christian Theology and the dynamics of modern missionary endeavour. In the course of a brief "Introduction", the author indicates the nature of the relation between Luther and Melanchthon and the general plan of the book and the arrangement. It is observed that *Melanchthon* is "but a case", "not the original", and would be treated "both as a subject and as object of our inquiry" (p. xiii). In the "Prelude", certain resemblances and contrasts between the personalities of Luther and Melanchthon are emphasized. In the first chapter Melanchthon's "Concessions to Tradition" are examined. The second is devoted to a discussion of "Concessions to Reason". The third deals with "Concessions to Law". The fourth examines the nature of "Concessions to Power", and the fifth (final) chapter contains an attempt at assessment of the value of nature and extent of "Concessions to Opposition". The territorial boundaries of "Adiaphora" and "Diaphora" are marked as it were and their limits discussed.

From the forementioned necessarily brief summary of the main contents of the volume it must be obvious that Dr. Hildebrandt has a complete and disciplined control over the Luther-Melanchthon literature, and he has brought out with striking clarity and balance of critical judgment the fact that in all respects in which Melanchthon felt obliged to strike a departure from Luther, the basic and fundamental determinant of such a departure should be deemed the pointed and definite leaning which Melanchthon felt for humanism the heritage of the hey-day of hellenic civilization. The different details in respect of which the rigour of the reformation of Luther had been toned down by the humanistic leanings of Melanchthon would bring home the truth that Melanchthon has to be regarded as an "ally" (simple, rational answer to the query posed as the title of the volume). "Current Science" in the sense of qualitative and quantitative laboratory analysis of phenomena would never have a warm corner for such theological discussions, and it is noteworthy that it is well nigh impossible to reconcile the modern doctrine of Evolution with the accounts of creation contained in the scriptures of the world, and conversely, such accounts with the scientific doctrine. The subject-matter and methodology of Theology would never admit of scientific verification (proof or disproof).

Going through Dr. Hildebrandt's discussions, one would easily realize that the controversies centering round biblical dogmatics and exegetics have their prominent counterparts in other systems of thoughts as well, say, for instance, the *Vedanta*, grounded on scripture *Sruti—Sastra*. The Christian theologian cannot with any sense of fairness or justification cast any

critical stones at the *Vedanta* and condemn it on account of its allegiance to scripture. Let this pass. In the chapter on "Concessions to Reason", it is stated: "Either he is saved by God's grace alone, or he is lost through his own fault—we must leave it at that ....." (p. 22). I am afraid it cannot be left at that. Man's fault cannot annul or cancel the saving grace of the Lord. Even those who declare acting under some abnormal or morbid urge for the nonce, "Evil be thou my good" must have a chance to save themselves. God's saving grace, however, must never be contingent, in fact it cannot be, on any denominational loyalty or allegiance to Christianity or the *Vedanta*.

The entire trouble is this. The grace of God cannot arbitrarily descend on this or that individual or community, and it appears reasonable to postulate that one should secure the necessary eligibility to become fit receptacle or recipient of God's grace. Unique in the history of human speculation, standing almost in a *sui generis* category, there is the planned program of psycho-physical or psycho-somatic purification outlined by the *Yoga-Darsana* which is intended to enable aspirants and devotees to make themselves eligible to receive divine grace. The system, its concepts, methods, and claims have yet to be studied under the controlled conditions contemplated by modern Experimental Psychology or Pure Psychology or Para-psychology, and whether the structural and functional changes effected by the practice of the *Yogic*-discipline can be demonstrated in a fool-proof manner is still an open question. I mention this just to illustrate that Christian Theism has to take its place side by side with other Theisms, share their vicissitudes, excogitate their problems and difficulties, and no philosophical specialties and theological reservations or even safeguards can be claimed on its behalf.

On page 98, Dr. Hildebrandt speaks of disharmony in Melanchthon between "concessions" and "confessions" and remarks that such is the fate of all who happen to be children both of Reformation and Humanism. But, then, there are very obvious limits to the concessions that can be legitimately made be it to Science or to Religion. Thus, there cannot be any concession at this distance of time as between the geocentric and the heliocentric world-views. One of them must be rejected as totally untenable. Likewise the scientist cannot be permitted to go on dogmatising adversely on the data of religion and philosophy simply because, they lie beyond the control and jurisdiction of laboratory methodology. It would be interesting endlessly to speculate. If Malenchthon had not administered a humanistic orientation or re-orientation to Luther's Reformation, would it have made a compelling dynamic appeal to the *intelligentia*, and the people at large? Taking a detached view, I feel, after a fairly careful study of Dr. Hildebrandt's illuminating analysis that the philosophical and theological excellences of the teachings and doctrines of Luther appear more alluring and inviting after the humanistic re-orientation administered to them by Melanchthon. Students of comparative religion and thelogy would unhesitatingly felicitate Dr. Hildebrandt on his analytical and arresting discussion of the relation between Luther and Melanchthon.

Madras, R. NAGA RAJA SARMA.
May 19, 1946.

M a y a.—Its Spiritual Exposition based on the Theory of Relativity. By Swami Madhav Tirtha. (Gnana Sadhana Ashrama, Chhota Udaipur, East Guzerat.) Pp. 107. Price Re. 1-0-0.

The relation between strict Laboratory Sciences on the one hand and Religion and Philosophy on the other has been a permanent and persistent problem, and with the fabulous and phenomenal advancement effected by modern sciences, the spectacle of Religion and Philosophy coquetting with the methods and conclusions of the scientific disciplines has been fairly frequent and insistently amusing. On the contrary, certain scientists have also not been wanting who have been reciprocating the coquettish contacts and advances with the result that a terrible type of hybridisation or cross-fertilisation has been irresponsibly effected, pointing to scientifico-metaphysical miscegenation. Swami Madhav Tirtha's undoubtedly brilliant volume under notice seems to me to be a striking instance of such a miscegenation. I wish it clearly to be understood that Swamiji's present effort is highly commendable and praiseworthy, but, after a careful study of the work the conclusion seems irresistible that Einstein's Theory of Relativity has no philosophical relation or intimacy with the doctrine of *Maya* as expounded and elaborated by masterminds and mastercraftsmen like Sankara in the course of the steady, systematic and progressive development of Indian metaphysical speculation. It will surely not be out of place, briefly to recall that Einstein formulated his Theory of Relativity in order to account of certain observed anomalies of movements in respect of the perihelion of Mercury and the General Theory and Special Theory, its vindications, repudiations and countless other vicissitudes have all been before the world of scholars now for a considerable time. Lord Haldane in his *Reign of Relativity* has worked out the philosophical implications of the theory in all its details and uncanny ramifications. It would be a mistake to suppose that the Theory of Relativity has been universally acclaimed and accepted without a murmur, or a challenge. Many of your readers will easily recall Shaw Suleiman's searching criticisms of Einstein. "The Case Against Einstein" is the arresting title of a well-known volume. It is against some such background as the above Swami Madhva Tirtha's attempted correlation between *Maya* and Relativity has to be examined.

In the course of his "Introduction", Swamiji observes that the doctrine of *Maya* which several find baffling, would considerably be simplified if *Maya* is understood as a "measure or a measuring instrument". The subsequent discussion stands arranged into *five* chapters,

each being devoted to a critical analysis and elucidation of a particular topic. Thus "Space", "Time", "Motion", "Causation", have a chapter each. In the fifth, Swamiji records in a striking and succinct manner "Philosophical observations" grounded on what he considers solid and substantial foundations of affinity between the theory of Relativity and the doctrine of *Maya*. Quoting from Eddington and others, Swamiji explains that the world as ordinary commonsense and science understand it seems "almost like a dream", "the mind makes the world", and so forth. It seems to me that in the interests of clarification of concepts and fixation of their legitimate conceptual boundaries, it must be pointed out that the General and Special Theory of Relativity as understood and elaborated in physics, pure and applied, in mathematics, pure and applied, and allied disciplines, has absolutely nothing in common with the doctrine of *Maya*, which is just the doctrine of illusionism formulated by the great Sankara on the twin-basis of scripture and reason. Philosophy in the distinctively Indian connotation of *Brahma-Jignyasa*, quest after the Ultimate Reality, neither gains anything nor loses anything from the Einsteinean Theory of Relativity. That changing co-ordinates of reference change the vision and view-point of the percipient of a particular spatio-temporal order of events or point-events throws no light whatever on the persistent issue in metaphysical speculation between *Idealism and Realism* or between *Illusionism* and *Realism*. That there exists a cosmic-order originating, growing, decaynig and perishing independently and irrespectively of knowing subjects endowed with different gradations of awareness of consciousness is the main thesis of *realism* which has not in any manner been dislodged from its position of metaphysical eminence and prestige by the Theory of Relativity.

Centuries ago, the relativity of time had been emphasised. An amusing attempt is made to correlate time as understood and felt here on this planet and time as felt and understood by the four-faced Brahma, the Creator. Students familiar with the doctrine of *Yugas* would know that corresponding to the millions of years that have now elapsed since the dawn of *Krita-Yuga*, the four-faced Brahma has been passing through forenoon just past eleven o'clock. He has just read his morning papers perhaps, and according to an almanac, Brahma has finished his oil-bath and is practising *pranayama*. This must illustrate relativity of time with a vengeance, but, it surely does not solve the problem whether this or that monad, or centre of awareness, or unit of experience has actually brought the world into existence at the moment of perception—whether *esse* is *percipi*. The Theory of Relativity has no useful contribution to make towards solution of the persistent issue or problem of philosophy—*Illusionism* vs. *Realism*.

That the attempted correlation between *Maya* and the Theory of Relativity paints a totally misleading picture would be manifest from the following thesis: "... there is no Reason for the Relative, no origin or cause of it, he has no purpose, and serves no end, and in no way does he increase the glory of the Absolute, since it is always the Absolute" (p. xi). If the Absolute is always the Absolute, sciences and humanities, history and progress, movement and evolution would all be the merest weariness of flesh, love's labour lost. Life has some meaning simply because, some entities *not* the Absolute are endeavouring for moral and spiritual perfection marking the nearest approach to the Absolute. I desire to comment on only one more statement of Swamiji. Swamiji observes: "Universal Relativity insists that motion of the source towards the observer is identical with motion of the observer towards the source. Therefore, whether God descends in the heart of the *Bhakta* or *Bhakta* ascends in the heart of God, the result is the same" (p. 55). There are here three distinct entities, namely, *motion*, *source*, and *observer*, and Relativity as interpreted by Einstein, and Swamiji does *not* mean that all the three are illusionistic appearances of one and the same Reality whatever it is. Nor can the result be the same when God descends and when the *Bhakta* ascends. If, in terms of religious and spiritual currency, ascent and descent signify the same result, such a movement must be pronounced sheer waste. It is neither scientific nor philosophical just to dogmatise that *somehow there is movement*, and that the "why" and "how" of it all can never be understood by the relativity-ridden intellect of mankind. When Swamiji compares the "*Swarup* of Sri Krishna" to "the gravitational field", I am powerfully reminded of a like comparison and explanation of the Gopi-Krishna dance (*Rasa-leela*) as a dance of electrons round a central nucleus and so forth. *Obiter dicta* like "... disturbance in the gravitational field is matter". "Matter is a symptom", "Causation is relative" do not throw any light of the nature of matter at all. The series of dazzling successful achievements of modern science beginning from the primitive locomotive and progressing through the Atomic-bomb to more astonishing and flabbergasting discoveries must be understood as strictly grounded on the deterministic postulate of Cause-and-Effect which certainly is not written off by the Theory of Relativity. Lastly, the Swamiji is employing mystifying terminology when he writes that a man "can expand his space-time fully only by living for the whole of humanity—for the good of all God's creatures". For, such an expansion of space-time must be the merest pursuit of will-o-the-wisp on the strict logic of Relativity itself, as the co-ordinates of reference must go on endlessly varying, and as no two of God's creatures would agree as to what their God or *Good* would be unless they are compelled to submit to a economico-political order by some absolute dictatorship or democratised dictatorship. All this would transport relativity to mysticism. And when the Swamiji seriously tells us that in this relativity-ridden world, "God regards not the greatness of the work but, the love with which it is performed" (p. 95) God's weakness or strength in responding to such love must become an otiose concept in all relativity-based schemes. On the whole, Swamiji's work is illuminating and thought-provoking. Scientists and philosophers would find Swamiji's discussion arresting and entertaining. Proof-reading may have been done

relatively more carefully. Sanskrit terms are amusingly mis-spelt (p. 67).

Madras, R. NAGA RAJA SARMA.
May 21, 1946.

Modern Petrol Engines. By A. W. Judge. (Chapman & Hall, London), 1946. Pp. viii + 509. Price 36/- net.

There is much in common between this book and a book by the same author and publisher, issued in 1945, entitled *Aircraft Engines, Vol. I* —which was reviewed by Prof. R. G. Harris in *Current Science* for March 1946. The same review might be applied to the present book as far as general comments go. It is thoroughly up to date within the limits of permission to publish, it is well and profusely illustrated, it gives the main results of recent research with the aid of tables and graphs, and it is well indexed and referenced.

The treatment is descriptive rather than profused but it provides a good background for more thorough studies of the various principles enunciated and bare results of researches given.

The book suffers from the limitation that no examples for working are given and its value for teaching purposes is limited accordingly but it will appeal to a wide class of technical reader.

Although it overlaps the other book mentioned, it covers the wider range indicated by its title and contains more recent material concerning aircraft engines.

May 20, 1946. B. C. CARTER.

SCIENCE NOTES AND NEWS

Quartz Reef at Anappara, Cochin State.—A small quartz reef has been discovered just to the west of Anappara hillock near Trichur, Cochin State. It runs in a N.E.-S.W. direction and is highly fractured. The quartz is white and has a specific gravity of 2·77. A sample was analysed and was found to contain 98·9 per cent. silica. Pieces of magnetite are found here and there in the quartz reef, and, in one place, a few flakes of biotite were also observed. The Anappara hillock consists of gneissic rocks, and the gneiss has a specific gravity of 2·8. This rock is quarried in two or three places for use as building stone and road metal. The quartz reef occurs as an intrusion into the gneiss.

Pyrrhotite Veins at Irimpanam, Cochin State.—A few irregular veins of pyrrhotite have been discovered during the blasting of the charnockite rocks at Irimpanam near Tripunithura. This mineral is mangetic and has a bronze colour and metallic lustre. Its specific gravity is 4·73. The chemical analysis shows that it contains 63·75 per cent. iron and 36·24 per cent. sulphur.

The Wodjina Tantalite Deposits, Australia.—For years tantalum has been used in the manufacture of special non-corrosive steels, electrical apparatus, pen parts, watch springs and various precision instruments. It can be beaten into plates and sheets as thin as paper and is much more malleable than gold and silver. It is capable of being drawn into wires so fine that when they are used to sew wounds they leave no scar. Research has also shown that tantalum can be employed in making butadiene, special lens glass of aerial cameras and spinnerets for making rayons. Engineers need the metal for pumps, valve parts, carbide tools and temperature control instruments.

During the war, scientists found that this wonder metal possessed a number of properties which previously had not been known, particularly in the field of surgery. It could be used plastically to remove disfigurements, and as a substitute for bone. Ordinarily, living tissues keep away from foreign substances, but with tantalum this is not so. Flesh, blood and bones cling so closely to it that surgeons are beginning to think that the living tissue actually attaches itself to the metal.

Tantalum was needed for a good number of urgent war purposes. In 1942 the Australian Government took over the Wodjina fields, and installed machinery to increase production. So great was the urgency that at times cargoes of the ore were flown out in American service planes. When it was found that electronic tubes using tantalum were needed for Radar, the urgency became even greater. In peace, as in war, tantalum will remain one of the world's most precious metals. Because of that, Wodjina will continue to be one of the really important places in the world.

Modern Radio Technique.—The Cambridge University Press announces a new series of monographs dealing with the advances in radio techniques made during war time. It is well known that the important success of Radar in the hands of the Allies was due to rapid advances in the radio techniques involved, and in particular to the development of ultra-high-frequency radio. All the monographs included in the new series will be by authors who were personally responsible for important advances in the subjects they write about. Mr. J. A. Ratcliffe is the general editor. Nine such books are now in active preparation; of which two, *Radio Navigation Devices* by Dr. R. A. Smith, and *Velocity Modulated Electron Tubes* by A. H. Beck, are complete and will go into production immediately.

Meteorological Office Colloquium, Poona.—Under the auspices of the above the following gentlemen spoke on subjects mentioned against each:—

24th May 1946, "Ice Accretion on Aircraft", MR. P. R. PISHAROTY.

30th May 1946, "Single Station Forecasting", F/O U. R. ACHARYA.

5th, 6th & 7th June, "Recent International and Empire Meteorological Conferences and the Meteorological Organisation in U.K. and U.S.A.", DR. S. K. BANERJI (*Director-General of Observatories*).

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